# Proceedings of the 45th Annual National Conference of the American Association of Zoo


## October 4th – 8th

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Four out of the five species of rhino face extinction within our lifetime. As part of its mission to ensure the survival of rhinos through conservation and research, the International Rhino Foundation (IRF) operates field conservation programs both in Africa and Asia. IRF focuses expertise and resources in areas where rhinos are in the most need of attention and where conservation efforts will have the most significant impact.

Fewer than 80 critically endangered Sumatran rhinos now remain on Earth, only in Indonesia. The population declined at a rate of 50% in the 1980s and 1990s from deforestation and habitat fragmentation, and despite protection, numbers still are decreasing across their range.

Bukit Barisan Selatan National Park (BBS) and Way Kambas National Park (WK) in Sumatra, Indonesia, are two of the three major habitats for Sumatran rhino, and are also two of the highest priority areas for other threatened megafauna, including the Sumatran tiger and Sumatran elephant.

The Javan rhino is also critically endangered, with around 67 animals in only one location: Ujung Kulon National Park in west Java. Ujung Kulon was Indonesia's first UNESCO World Heritage Site -- is the largest remaining lowland forest site on the island of Java. Ujung Kulon also is home to a number of other endangered species, including the Javan gibbon, ebony leaf monkey, Javan leaf monkey, leopard, fishing cat, Javan hawk eagle, and the banteng, a species of wild cattle.

With our partner, Yayasan Badak Indonesia (YABI or the Rhino Foundation of Indonesia), the IRF funds and co-manages a comprehensive program aimed at protecting and increasing the populations of Sumatran and Javan rhinos. Rhino Protection Units (RPUs) are the backbone of this program. Both of these rhino species still survive largely because of long-term funding provided by the AAZK Bowling for Rhinos program, which for more than 20 years has been a major source of funding for their conservation.

The initial decline of Javan and Sumatran rhinos was due to poaching for horn, which is used in traditional Chinese medicine to reduce fever. Now, the populations are primarily threatened by small population effects, such as the Allee effect, inbreeding, and other issues. They also are limited by available suitable habitat, which particularly in BBS, is

continuously being encroached by human populations and converted for small-scale agriculture.

RPUs are highly-trained, four-man anti-poaching teams that intensively patrol key areas within Indonesia's national parks. Each RPU is led by a park guard who has the authority to carry a weapon and make arrests; the other three members are recruited from local communities. RPUs monitor threatened wildlife, deactivate traps and snares, identify and apprehend illegal intruders, including poachers, and investigate crime scenes, thus preventing or reducing the loss of wildlife. Each unit spends at least 15 days per month on patrol. In 2018, the majority of illegal activities encountered included non-mammal poaching (fish, birds), illegal logging, and encroachment, often in the form of small plots of illegal coffee crops, especially in BBS. In Way Kambas, seasonal forest fires are a common event; RPUs often assist park authorities in putting them out.

As part of their continuing efforts to turn back encroachment, in partnership with BBS park authorities, the RPUs also have helped to removed nearly 150 squatter settlements from within the park boundaries this year.

Thanks to the RPUs, there has been no evidence of poaching of Sumatran rhinos in BBS and Way Kambas National Parks in Sumatra for the past 18 years, or of Javan rhinos in Ujung Kulon National Park in Java for more than 20 years. The RPUs also protect numerous other threatened species, including Sumatran tigers, elephants, tapirs, sun bears, gibbons and siamangs, clouded leopards, fishing cats, and numerous bird species.

**India**

Greater one-horned, or Indian, rhinos now number about 3,550 and the population slowly continues to increase. IRF's ambitious project, Indian Rhino Vision 2020, implemented in partnership with the government of Assam, WWF-India, and the Bodo Territorial Council, aims to increase the rhino population in India to 3,000 by 2020 by moving animals from concentrated populations to areas where rhino populations are not as dense.

Since the project's inception, we have translocated 18 animals to Manas. Another eight rescued rhinos have also been released. Post-release, animals have been closely monitored using radio-collars and direct observation, both from elephant back and on foot. IRF was awarded an AAZK BFR Conservation Resource Grant in 2010, which helped to fund the purchase of five radiocollars to assist daily monitoring of the translocated rhinos.

Thus far, we have had ten rhino births, and, sadly, eight rhinos were lost to poaching. The last poaching event was in 2015 and, as were several others, was attributed to Maoist insurgents coming across the border. The park's population now stands at 32 animals and the population continues to grow.

**Conclusion**

The IRF is grateful for the steadfast investment that the AAZK membership, through the Bowling for Rhinos program, has made towards rhino conservation. Asian rhino species continue to face enormous challenges, but without a doubt, they are in much better shape than they would be without the support of this dedicated organization. And, in particular, we might have already lost the Javan and Sumatran rhino had the AAZK not had the foresight to heavily invest in their protection many years ago.

The IRF is grateful for our partnership with AAZK, and for the dedication of all of its members to conservation of rhinos as well as this planet's other magnificent species. In the face of the enormous challenges facing Indonesian rhinos, AAZK's support for their conservation has never been more critical.

# Action for Cheetahs in Kenya: National Cheetah Survey

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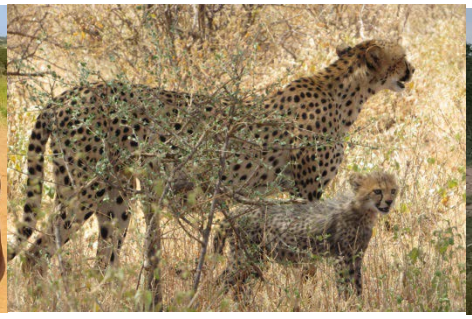
**Abstract**:

AAZK Bowling for Rhinos supported Action for Cheetahs in Kenya efforts since 2010 enabling us to develop a field base in northern Samburu and to implement our second range wide survey of cheetahs in Kenya. As a grass roots project under the registered organization of Carnivores, Livelihoods and Landscapes, Action for Cheetahs in Kenya is the only range wide cheetah conservation organization in Kenya. The project employs Kenyan community members and encourages the development of conservation leadership through training and higher education opportunities for our staff. This presentation updates AAZK members on the status of projects and the benefits of the BFR funding for long-term cheetah conservation efforts in collaboration with other local and international partners.


***Photos: Samburu rabies campaign – Lekerimui and county veterinarian vaccinating a puppy, Cheetahs in Buffalo Springs National Reserve, Scat detection in Galana (northeastern Kenya)***

## INTRODUCTION

***ACK Mission:*** *Promote the conservation of cheetahs through research, awareness and community participation in Kenya*

Action for Cheetahs in Kenya (ACK) previously operated as the "Cheetah Conservation Fund (CCF) – Kenya" program from 2001 – 2008 and was co-founded by Dr. Laurie Marker. ACK was the first project under the umbrella of Carnivores, Livelihoods and Landscapes (CaLL) in 2009.The project is still affiliated with CCF and works in collaboration with the Kenya Wildlife Service (KWS) and the University of Nairobi (UoN) along with other local collaborations.

In 2010, when ACK began receiving funds from Bowling for Rhinos (BFR) we had just opened our Salama field site and had recently completed the first national survey of cheetahs across its entire Kenyan range. Throughout the cheetah's range it is vulnerable to the threats that lead to wildlife population

decline. It is estimated that overall cheetah decline is at a rate of 2.1% annually. Kenya holds a cheetah population that is central to the whole of eastern Africa and we estimate the Kenya population to be 1200-1400 based on studies completed in 2007. The trans-boundary issues with neighboring Tanzania, Uganda, Ethiopia, South Sudan and Somalia create a contiguous population facing similar threats (Durant 2016 ). The future of the cheetah is threatened by land fragmentation, loss of critical habitat and conflict with people.

Today, ACK employs 18 Kenyans at two field sites with three departments – Research, Education and Detection Dog teams. ACK has three employees in higher education programs and supports between five and ten local and international university student projects annually. We work in two communities where over one-tenth of Kenya's cheetahs live within farming communities. In 2017, we launched our second national survey after completing pilot occupancy modeling studies in our two field bases. In 2017, we successfully isolated genetic fragments from cheetah scat samples collected through detection dog identification. In 2018, we field tested the dogs at four locations, completed our pilot genetics work, and initiated interview methods for the next phase of the survey. Additionally, we completed student education materials and a conflict mitigation tool kit which will be distributed during the national survey.

## RESEARCH

In the Samburu study site we have focused on habitat monitoring and on testing deterrent methods to reduce losses to night time predators.

Wildlife patrols show a slight increase in predators and prey since the end of a multi-year drought. Efforts in community conservation work in collaboration with the Meibae Conservancy, through the Northern Rangelands Trust.

Deterrent lights installed between 2014 -2016 continue to show that the Lion Elephant Deterrent Light Systems (LEDS) were the most effective. New independent solar lights have replaced all of the technically challenging linked solar systems. This year an additional 60 lights will be tested thanks to a Wild Aide grant. Review of our conservation effectiveness in education and awareness projects is underway through an undergraduate intern from the University of Nairobi.

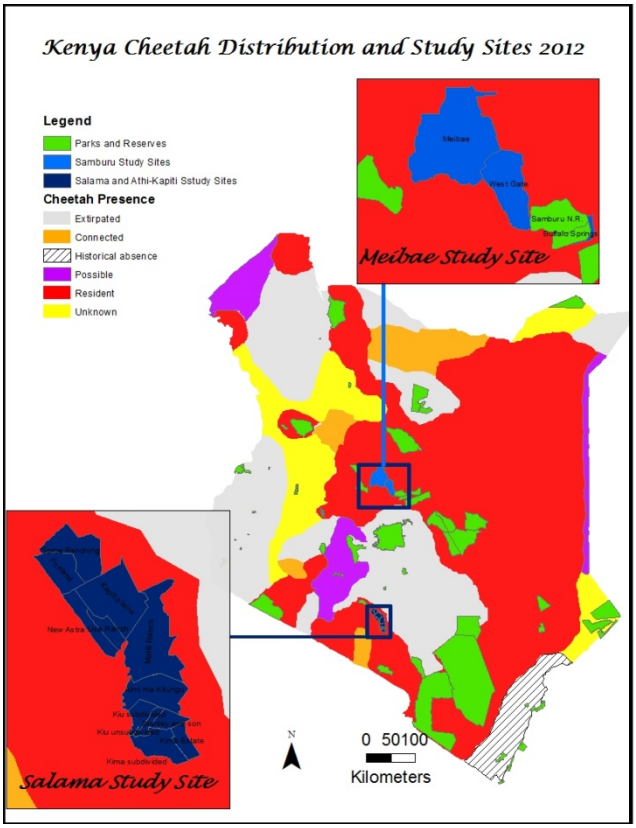



***Figure 1: ACK research areas in southern and northern Kenya.***

We conducted a scat do seminar with the three handler institutions that have been advising on our training. As a result the institutions have endorsed our dogs and handlers as being ready for professional level field work. The fecal detection team spent four months at the Salama research site, three months in the Samburu site and two months in new field sites.

In the past year there have been three incidents where cheetah cubs were removed from the mother. In two cases, one or all of the cubs were returned and accepted back by the mother, but in two cases where the cubs could not be returned they died in the care of KWS. In April 2018, six cubs were rescued from community persecution near our Salama site and we were given permission to raise the cubs.

After taking the cubs to a ranch in Laikipia the cubs health declined due to a virus and five of the six died. It is evident that the rate of negative human impact on cheetahs is increasing. Additionally, cub confiscations in Somaliland and Tanzania is on the increase. ACK is evaluating the need and feasibility of developing a dedicated cheetah conservation and rescue center.

**AWARENESS**

Due to political insecurity, the 2017 football cup associated with International Cheetah Day (ICD) was cancelled. ACK donated 100 trees to three schools in celebration of ICD and initiated plans for the 2018 football cup to resume in 2018. Alive and Kicking, donated 6 footballs that were dispersed in late 2017. In June 2018, ACK and a local partner purchased new sports field equipment for 5 schools - football, netball and volleyball goal posts, nets and balls. We also installed three motorcycle shade structures per request of the youth.

ACK partnered with several local institutions to implement a rabies campaign and vaccination program in affiliation with the Samburu county health department and the Meibae Conservancy. The vision for Africa is to eliminate rabies by 2030 through awareness and vaccination campaigns. In December 2017, we vaccinated 711 dogs and 74 cats over a three day period. Dogs are recognized as the primary carriers of rabies which can be transmitted to other domestic or wild animals and to people. Rabies is a transmitted disease that kills more than 2000 Kenyans annually. The majority of the deaths are children under 15 years old.

**NEW AFFILIATION**

In April 2018 the CaLL board of directors in Kenya and the USA voted to accept an affiliation proposal from Dr. Elena Chelysheva, founder and director of the Mara Meru Cheetah Project (MMCP). Dr. Chelysheva has been based in the Mara since 2012 conducting behavioral studies on cheetah social groups. Although we have been working informally on elements of fecal analysis and cheetah monitoring, it is only this year that we have formalized our affiliation. As the MMCP expands into the Meru region, they will need to hire more staff and to expand their resources. The project will benefit from the infrastructure available through CaLL and it will help us build our credentials and outreach in Kenya.

**CAPACITY BUILDING**

Building capacity and setting up networks is important to assure staff are well equipped for being leaders in the conservation field. Several Kenyan and international students participated in training and coursework. Field officer, Chris Lentaam, is completing an undergraduate degree in Conservation Project Management at Mt Kenya University in Meru Kenya. Senior Scientist, Sarah Omusula, completed the first year of a Master of Science degree at the Yale University School of Forestry and Environmental Studies. Noreen Mutoro began her coursework for a PhD at the Technical University of Munich in Germany. Four staff members (Evans Odundo, Noreen Mutoro, Mary Wykstra and Chris Lentaam) attended the Pathways to Human Dimensions in Conservation (Colorado State University) conference and seminars at the CCF in Namibia**.** Noreen, Mary and Chris presented on the National Survey, Digital Data and Deterrent light testing respectively**.** Master's student, Brian Mlamba, attended three months training on genetic sequencing and analysis at CCF. Sarah Omusula attended the Zoo's and Aquariums Committing to Conservation (ZACC) conference and presented a poster on the national survey and scat dog proramme.

As ACK continues to grow our projects student projects help to benefit the capacity building within and the future leaders in the conservation field. Brian Mlamba (Kenyatta University) and Hafeni Hamalwa (University of Namibia) will complete their Master's thesis on Kenya cheetah genetics in 2019. Peter Kibobi (University of Eldoret) will complete his master's thesis on the impact of linear development (hihways) on wildlife in the Salama area for graduation in December 2018. Sonora Kameron (Colorado State University) will complete a master's project by publishing the conflict mitigation tool kit using the methods of mitigation that we recommend. Three University of Nairobi students, Cheryl Umalla (thesis on use of dogs in conservation), Mercy Lipina (development of rabies and disease awareness), and Adelaide Moturi (effectiveness of awarenss programmes in the Salama community) will complete internships in 2018 and one intern (Geraldine Mburu) completed her project (development of a student learning guide) in 2017. John Wachira (University of Nairobi) took an extension on his masters project evaluating the trends of wildlife in the Salama area. Previous students completed their thesis and/or publications – Juliana Masseloux (BSC Oregon State University) achieved publication in the African Journal of Research *(Using detection/non-detection surveys and interviews to assess carnivore site use in Kenya)* and Alysa Hansen (Antioch University New England) defended her MSc thesis on the use of deterrent lights in Samburu. Jan Jedersberer published results of implementation of the digital data application. Mary Wykstra and Sarah Omusula are co-authors on several chapters in the Elsevier Cheetah : Genes to Landscapes book published in December 2017. A film crew from NTV (Nation Media in Nairobi Kenya) is producing a follow up documentary on ACK work focusing on plight of the Nairobi National Park cheetahs.


***Photos: Motorcycle shade structures built to create awareness for young men in Meibae, Cheetah on a kill in Galana Conservancy (eastern Kenya), Building sports for conservation groups in Meibae Conservancy***

**2017 – 2018 FINANCIAL REPORT**

The primary source of income for ACK activities in the Samburu study site is from Bowling for Rhinos. Funding through zoo grants and AAZK chapters support the long-term conservation efforts and other regions of ACK focus. Students and volunteers are self-funded or utilize funds through joint grants with ACK. Below is the income and expense for 2017 - 2018 for the Samburu project and national survey funded through BFR. The full operational budget for ACK in 2017 was $127,570.

***BFR INCOME 2017-2018***

| | |
|---|---|
| Received BFR 2017: | $45,571.11 |
| Received BFR 2018: | $ 46,168.00 |
| Total Available: | $91,739.11 |

***BFR EXPENSES 2017 (January – December)***

| | |
|---|---|
| Meibae Conservancy Fee | $ 500.00 |
| Field Officer Stipend and training | $ 9,100.00 |
| Transport (Fuel, Insurance, Public service) | $ 6,900.00 |
| Accommodation (Camping fees, lodging, food) | $ 2,000.00 |
| Camp Construction and Maintenance | $ 13,000.00 |
| Office Equipment and Supplies | $ 2,000.00 |
| Community Programmes | $ 6,000.00 |
| Genetic and Occupancy modeling | $ 8,000.00 |
| **Expenses 2016** | **$47,500.00** |

***Expenses 2018 (January – June)***

| | |
|---|---|
| Meibae Conservancy Fee | $ 250.00 |
| Field Officer Stipend and training | $ 5,700.00 |
| Transport (Fuel, Insurance, Public service) | $ 4,200.00 |
| Accommodation (Camping fees, lodging, food) | $ 2,300.00 |
| Camp Construction and Maintenance | $ 2,000.00 |
| Office Equipment and Supplies | $ 500.00 |
| Motorcycle Fuel & maintenance | $ 2,500.00 |
| Community Programmes | $ 3,200.00 |
| Genetic and Occupancy modeling | $ 5,000.00 |

**Expenses to Date 2018 $25,650.00**

**Balance as of 1 July: $18, 589**




***Photos: ACK staff training with Salama and Samburu field team, Cheetah cub from Konza aea of Salama study site, Staff training with detection dog intern and assistant handlers, Planting trees for International Cheetah Day in Salama schools.***

**PROJECT GOALS AND ACTIVITIES 2019**

The following goals will be achieved by ACK staff.
Goal 1: Identify factors affecting cheetah livestock predation and mitigate conflict.
*a. Prey Distribution and Abundance:* Continue to collect and analyse field data from transects and patrols at Salama and Samuru study sites.
*b. Human Settlement Pattern:* Complete analysis *of s*atellite images from 2008 – 2016 to evaluate changes in land use and human settlements across the cheetahs range based on pilot projects in Salama and Samburu field sites.
c. *Evaluate Livestock Depredation:* Complete conflict mitigation tool kit for distribution in 2019, continue monitoring deterrent lights, and expand domestic animal health projects.
Goal 2) To understand cheetah health and habitat selection
a. *Monitor cheetah presence and movements through observation:* Continue to implement monitoring methods including direct observations, camera trapping, spoor counting and verification of public sighting reports. Use ArcGIS for analysis and comparison of annual and seasonal cheetah movements and corridor use.
b. *Determine habitat use of cheetahs in relation to vegetation and prey*: Use boma monitoring, Vegetation surveys and highway monitoring to report human impacts on cheetah status.
Goal 3: Influence public and administrative changes to positively affect cheetah conservation and management protocols.
*a. Conduct community programs to disseminate findings, promote conservation awareness, and improve livestock management techniques (public meetings called baraza)*: Use natural resource planning to establish strategies for resource conservation and improved livelihoods.
b. *Raise environmental awareness through partnerships and internal education programmes for communities and schools*: Show wildlife videos at schools.
c. *Establish cheetah conservation protocol and the policy in collaboration with KWS and local stakeholders*: KWS and local administrative offices hold the power of prescription that guide procedures within the human-wildlife interface, thus the knowledge they receive assist in their decisions and actions. ACK provides quarterly updates to KWS and we present our research findings at an annual Carnivore Action Forum meeting. We submit updates to the National and Regional Wild Dog and Cheetah Strategic Plans to assist in the framework of cheetah conservation. Printed materials and digital submissions through our web site create awareness of activities and findings.

Biography

Durant, S. M., Mitchell, N., et. al (2016). "The global decline of cheetah Acinonyx jubatus and what it means for conservation." Proceedings of the National Academy of Sciences of the United States of America.

# When less is more: Adapting Black Rhino conservation targets in response to long-term ecological and population data

David W Kimiti[1], Geoffrey Chege[2], Ian Lemaiyan[3], Lara Jackson[4]

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2. Head of Conservation and Wildlife, Lewa Wildlife Conservancy, Kenya
3. Rhino Monitoring Officer, Lewa Wildlife Conservancy, Kenya
4. Graduate Student in Wildlife Conservation, Southampton University, United Kingdom.

## Introduction

The black rhinoceros, *Diceros bicornis*, is currently listed on the IUCN red list as critically endangered, with the global population estimated at 5,040-5,458 individuals (Emslie et al., 2016). Majority of these animals reside on protected areas that have a high level of security and patrol effort and rely on government, private and community support, and scientific research to thrive (Amin et al., 2006; KWS 2016). The eastern Black rhinoceros subspecies (*D. b. michaeli*) has fewer than 800 individuals across Africa and has been the focus of intensive conservation efforts continent-wide. In Kenya, the government, primarily through the Kenya Wildlife Service, mainly drive these conservation efforts through a public-private partnership with private and community owned conservancies.

On Lewa and Borana conservancies in Kenya, which are co-managed as one landscape, there are a total of 87 black rhino. This population was first introduced in 1984 when a portion of the landscape was set aside as a rhino sanctuary with a founder population of 15 black rhino, before the current conservancy was established in 1995. Since then, the population has expanded remarkably, both through translocations in as well as natural births. Lewa is especially unique among Kenya rhino sanctuaries by not having experienced any successful poaching events over the last five years. This is as a direct result of intensive ecological management, investment in state of the art security technology, and invaluable goodwill from surrounding communities.

While this black rhino population has been intensively managed for the last 30 years, and the population is encouragingly at an all-time high, the long-term population performance had not been analysed in its historical entirety prior to 2017. As such, population performance metrics and their relative changes over time, especially in response to reduced browse availability, were as yet undetermined. In 2017, the Lewa-Borana Research department collaborated with Keryn Adcock, a member of the African Rhino Specialist Group (AfRSG) to collate and interpret long-term data collected on the Lewa portion of the Landscape, which holds 62 of the LBL's 87 black rhino. The goal of this exercise was to facilitate better visualization and analysis of long-term Black rhino performance on Lewa, identifying important trends and discussing possible ways to further enhance the Lewa-Borana Black rhino management strategy.

**Materials and Methods**

Individual life statistics data were collated from all black rhino to ever be born, die, or be translocated into or out of Lewa since 1984. All births, deaths, and translocation events were confirmed through hand written records and rhino databases.

All raw data was fed into a proprietary automated excel-based workbook that was set up by Keryn Adcock. This workbook system is set up to automatically calculate age at first calving, inter-calving intervals, underlying biological growth rates, actual growth rates, sex ratios, as well as overall population structures. The interactive nature of the system allows different datasets to be included or excluded. As such, we were able to look at life tables under different scenarios, including with translocations in or out of the population excluded.

Growth rates were calculated as three year moving windows to account for spikes and troughs occasioned by time offsets from the prolonged gestation periods in black rhino and variations in breeding related to good or bad rainfall years. To calculate biological growth rates, human induced mortalities were treated as removals, while actual growth rates were calculated with human induced mortalities included. For simplicity, here we only present data from the last 17 years.

## Results and Discussion

In general, the Lewa black rhino population exhibited increasing numbers and population growth rates before reaching a peak between 2004-2006. Thereafter, while overall numbers remained high, the population exhibited lower growth rates over time. Our analysis of these observations in combination with knowledge of management interventions across the same period allowed us to develop three distinct phase classifications that sought to contextualize these trends.

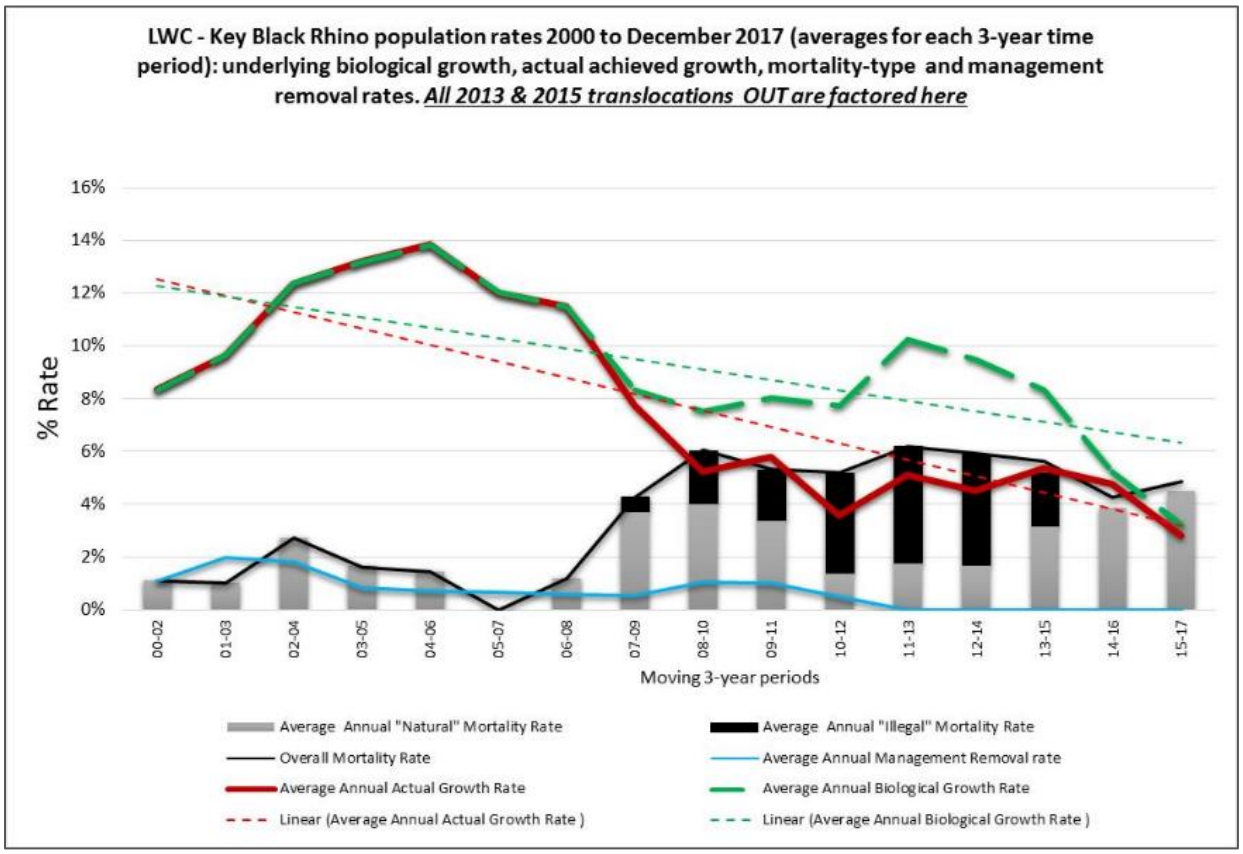


**Figure 1:** Graph showing key black rhino population rates as at January 2000 to December 2017

**Phase one**; between 2000 and 2007 the conservancy recorded rapid population growth as low population meant there was surplus browse for the black rhino species. Maintaining a lower population size and increasing browse availability has been shown to have a positive effect on rhino population growth, especially in enclosed sanctuaries (Adcock & Elmslie, 2003; Adcock 2004).

**Phase two**; between 2008 to 2013, Lewa experienced reduced growth rate due to human induced and natural mortalities. During this period, drought played a major role in reducing browse availability for rhino and increasing competition as other mega herbivores like elephants moved into Lewa. Deficiencies in browse availability can reduce rhino productivity as well as induce calf mortalities due to insufficient nutrition to calves from the mothers (Muya & Oguge 2000). At the peak of this period, poaching was a major problem, further reducing the actual growth rates through to the end of 2012-2013 (Fig. 1).

**Phase three**; between 2013 and 2017. After human induced mortalities were eliminated, management interventions to move out rhino came into place. In 2013, 11 individuals were moved to Borana Conservancy, which is co-managed as a single contiguous landscape with Lewa. In 2015 nine individuals were translocated to Sera Community Conservancy. These translocations only minimally enhanced the overall growth rates, and this was exacerbated by natural mortalities through to the end of the period in focus. In the most recent three-year rolling period, between 2015 and 2017, the average annual biological growth rate was about 1% while the average annual mortality rate stood at 6.2%, with natural deaths being the main causes for the low growth rate during this period.

We further conducted a comparative analysis to find out if the population performance would have been significantly different if translocations out had not happened, and all other factors remained constant. The findings show that between 2013 – 2017, the average biological growth rate would have only been enhanced minimally in each 3-year moving average if translocations had not taken place (Table 1).

This analysis clearly shows that the downward trend in population growth rates would have continued even without human intervention. In the absence of other confounding factors like disease and predation, this slow-down in growth rate is most easily explained by nutrition or density-dependent reductions in fecundity. A large part of this probable nutrition stress can be attributed to the less than ideal rainfall conditions experienced across the landscape during this period.

**Table 1 -** Comparison of *actual* and *biological* growth rates with and without rhinos that were translocated OUT of Lewa in 2013 and 2015

| | **Moving 3-year windows** | | |
|---|---|---|---|
| | **13-15** | **14-16** | **15-17** |
| Average annual actual growth rate *(rhinos translocated OUT in 2013 & 2015 are excluded here)* | 4.7% | 3.3% | 1% |
| Average annual actual growth rate *(rhinos translocated OUT in 2013 & 2015 are included here)* | 5.4% | 4.8% | 2.8% |
| Average annual biological growth rate *(rhinos translocated OUT in 2013 & 2015 are excluded here)* | 8.2% | 3.9% | 1.1% |
| Average annual biological growth rate *(rhinos translocated OUT in 2013 & 2015 are included here)* | 8.3% | 5.2% | 3.2% |

Much of the low growth, however, is likely tied to the fact that Lewa has effectively reached its estimated Ecological Carrying Capacity (ECC). Figures from 2006 estimated the ECC to be 70 animals. Currently, the conservancy is occupied by 62 animals; close to this original ECC estimate. However, social pressures always set in even before the ECC is explicitly achieved. Furthermore, these figures assume a static forage base, and the Lewa landscape has experienced a significant reduction in woody vegetation over the last 20 years.

Most instructively, *Acacia drepanolobium*, which constitutes 63% of the black rhino diet on Lewa (L. Jackson, unpublished report), has seen a 5.6% reduction in cover over the last 38 years (Giesen et al., 2017). This decrease in the density and cover of woody vegetation has been attributed to an increase in megaherbivore populations and varying precipitation patterns. In addition, erratic rainfall and the general reduction of other preferred black rhino browse makes it likely that the current ECC is lower than historical estimates, and that the Lewa population has

already surpassed the actual current upper density limit. Previous studies have established that in enclosed populations with low mortality rates, markers of productivity like age at first calving and inter-calving intervals tend to be density-dependent (Rachlow & Berger 1998; Law et al., 2013). In addition to impacts on nutrition and calf survival, increased densities also have an impact on social behaviour, including through increased territorial conflicts, which can affect breeding and calf rearing.

**Conclusion and implications for conservation**

The reduction in growth rates of the Lewa black rhino population following successful achievement of high densities closely parallels trends observed in other enclosed or small rhino sanctuaries, and these sanctuaries offer insights into the best interventions to halt and reverse these trends. The most immediately available solution is to reduce the density of black rhino on Lewa. This can be achieved through translocation to other sink sanctuaries and has been done on Lewa in the past, in close collaboration with the Kenya Wildlife Service and other partners. The improvement in population growth post translocation is likely to reduce over time and therefore, continuous translocation out is encouraged. Lewa therefore needs to focus efforts on supporting development of suitable new black rhino range or expansion of current black rhino habitat.

This strategy would allow a set offtake to be established for the resident population, which would likely lead to a commensurate response in growth rate. By focusing on annual growth rate as opposed to overall rhino numbers as a population productivity marker, management would be able to both maintain the health of Lewa's black rhino population as well as provide source animals for new or expanded sanctuaries across Kenya. This would support Kenya's black rhino management strategy and contribute significantly to increasing Africa's black rhino population, helping push this iconic species further away from extinction.

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# Bowling for Rhinos Program Update

*By: Kym Janke, Lead Keeper*
*San Diego Zoo*
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*Bowling for Rhinos Program Manager*

A lot has changed with the Bowling for Rhinos program over the past couple of years and we are just getting started! Thanks to the hard work and dedication of all of AAZK's members and community supporters the BFR Program had grown to a point that a team of enthusiastic people were needed to help run and grow this amazing conservation initiative. As many of you may know AAZK made the decision two years ago to formalize the BFR Program and structure its management and oversight in the same manner as it runs all of its other programs and committees. The BFR Program team members come from all over the United States (Canada where are you?) and make up a diverse team of varied experience and years of involvement. Kym Janke is the program manager and has been involved in BFR since 2007; Matt Mills is the program vice-manager and has been involved in BFR since 2011; Kate Clemens is the Communications Liaison and has been involved in BFR since 2014; Kevin Shelton is our Conservation Partner Liaison and has been involved with BFR since it started in 1990; Lisa Haggadone is the Event Coordinator and has been involved in BFR since 2015; Selenia Murillo is the Conservation Resource Grant Coordinator and got involved in BFR this year! Finally we have the benefit of solid guidance and leadership from Azzara Oston who serves on AAZK's Board of Directors and keeps us all in line!

Bowling for Rhinos continues to be the most successful keeper run conservation program. We should all be so proud that to date we have raised an impressive $7,242,619.47! Our 2017 total was the highest yet with $607,580.69 supporting our incredible conservation partners; Lewa Wildlife Conservancy, International Rhino Foundation, and Actions for Cheetahs Kenya; as well as providing funds to Save the Rhino Trust through the Conservation Resource Grant for conservation efforts aimed at the Black Rhino population in Namibia. I urge all of our members to follow these organizations on social media to stay up to date with the important work they are doing in the field.

As the Bowling for Rhinos Program grows we are evolving and growing with it. Our goal is to enlist the support and participation of 100% of AAZK's amazing chapters! If your chapter holds a yearly Bowling for Rhinos event, we thank you for your continued support and achievements! If your chapter does not hold an event, we have only one question: Why not? Did you know that Bowling for Rhinos events do not have to involve bowling at all? The program team would love to speak with you and help you develop an event suited to your chapter, town, and audience! One of the main focuses of the BFR Program has been the development of tools that will help every chapter succeed. Lisa has been an essential resource to many of you, Kevin has been in constant communication with our wonderful conservation partners, and Kate has been doing an absolutely fabulous job at keeping our membership informed of all things BFR through frequent social media posts.

So what has stayed the same with the BFR Program? Our enthusiasm and passion for conservation has never been greater! We still encourage chapters to hold fun filled events that raise the funds our conservation partners rely on and we incentivize this by offering each of the four highest raising chapters to nominate one individual who will receive a trip to either Lewa Wildlife Conservancy in Kenya or to Indonesia with our partners at International Rhino Foundation. 100% of the funds raised through the many BFR events held annually are used in conservation efforts; that is why we ask chapters to remit a sanction fee before planning the event. This sanction fee covers all the administrative costs associated with a charitable event of this size, rest assured that all the dedicated BFR Program team members are volunteers who want to see as much money go to conservation as possible! If the amount of money totaled from the sanction fees exceeds the actual administrative costs then this surplus is put right back into the Bowling for Rhinos event totals for that year.

What has changed with the BFR Program? The way that the Anna Merz Champion Award is selected was changed last year. Each chapter has the opportunity to nominate one member who has made a difference in their BFR events and all chapters (with the exception of the four highest raising chapters) have the chance that their nominee will be randomly selected to win a 10 day trip to Lewa Wildlife Conservancy! We want to ensure that every chapter, no matter how large or small, has an equal opportunity to win a trip.

Do you know a deserving individual or organization that is conducting research or conservation initiatives aimed at rhinos, their habitats, or the local communities? If so then please make them aware of the Bowling for Rhinos Conservation Resource Grant (CRG). This year was the first year that the BFR Program team was involved in the grant selection process, as this was formally handled by the Conservation Committee. BRF team member Selenia is working on establishing constant and open communication with the BFR Conservation Resource Grant recipients. Our goal is to make AAZK members more aware of the diversity of support BFR offers through this grant and increase the visibility of the conservation work accomplished as a result. The CRG is supported by 2% of funds raised through BFR and is awarded each year; this can make a huge difference to a research/conservation budget! Eligible projects not only include in-situ work but can also be based on ex-situ rhino conservation and research. Help us spread the word!

The BFR Program team has also been very busy developing some new tools that will help streamline the BFR sanction process, provide resources to chapters, and aid in the organization of more successful events. Over the coming year we will be pioneering a mentorship program where successful, veteran chapters will offer guidance and ideas to newer chapters of similar size/geographic areas. We are also compiling a FAQ that will be shared with all BFR coordinators through a Google Drive with easy access to a variety of documents including one we are putting together outlining tips and tricks for successful events and insight from past trip recipients. We hope that through the Drive we will be able to minimize the number of forms and documents distributed through the sanction packet and instead have them all located in one place with no need to worry about a deleted email or a new email address.

We have also been reviewing the website and all forms and documents associated with BFR to ensure that everything is up to date and that redundancies are removed. We appreciate your patience as we work through the massive amounts of documents compiled over the last 28 years!

Conference 2017 also introduced some changes to better embrace and celebrate all the deserving conservation initiatives of AAZK members. The BFR Rally was replaced with the Conservation Rally, because no matter how biased I may be (Go Rhinos!!), there are a lot of deserving AAZK Programs aimed at helping the planet and all that call it home. The biggest and most positive change to the conference schedule was the addition of the BFR Summit. This one hour forum allowed AAZK members the chance to network, get answers to questions, and hopefully sent them home with many great ideas on how to run a smoother, more successful event! We hope that this summit grows to be one of the best foundational tools for chapters to use and encourage everyone to attend!

Do you have a suggestion or a comment on something you would like to see the BFR Program do or improve? Do you have an idea to increase participation in order to reach our goal of having every chapter support this worthwhile cause? If you do then please do not hesitate to contact any of the program team, we will be delighted to hear from you!

We are looking forward to 2018 being the most successful year yet since, as we all know, the rhinos need all the help they can get. With our diverse conservation partners focusing on rhinos, habitats, communities, and a wide range of wildlife it is so amazing to know that our efforts ARE making a difference. We couldn't do it alone and are excited to see what lays ahead!

# Ostrich Training—The Sky is the Limit

By

Kayla Chambers & Cory Gordon

Disney's Animal Kingdom Lodge

Lake Buena Vista, Florida

## Introduction

Typically, ostrich husbandry and medical care requires some method, and or technique, of manual restraint. These methods allow keepers to perform a variety of necessary husbandry and medical needs: blood collection, banding, injections, and overall body palpation. However, these procedures come with inherent risk that can be unsafe for both the keeper and the animal. Disney's Animal Kingdom Lodge (DAKL), is now transitioning best practices in ostrich care from manual restraint to voluntary operant conditioning techniques for a few birds in their collection. DAKL currently houses five female ostriches ranging in ages from 2 to 20 years. One ostrich in particular, Anna Belle, was lame and developed swelling around her metatarsophalangeal joint. The veterinary staff wanted to test her blood values. Current practices of obtaining blood was not successful due to the level of stress and risk associated with manual restraint, so the training of voluntary blood draw was initiated. Keepers developed voluntary blood draw training protocols on all five ostrich which also led to several other behaviors that could be performed voluntarily.

## Blood Draw

To begin with blood draw training we got our ostrich accustomed to tactile all over their bodies. We slowly introduced multiple keepers and managers into the stall where the ostrich was housed. This allowed the ostrich to have different people in their surroundings knowing that during a typical blood draw procedure there would be keepers, managers, and veterinary staff. Trainers would continue to do tactile and begin lifting up their wing. We used a butterfly needle that still had the cap on or a paperclip to apply pressure to the underside of the wing to simulate a blood draw. During the blood draw, a trainer would begin tactile along the wing while the other trainer stood to the side with their arm extended to feed soybeans at a safe distance. While the trainer did tactile along their wing, we would lift it to allow the veterinary staff better access to the underside where veins were visible.

## Radiographs

Radiographs had to be taken in various locations throughout our ostrich's, Anna Belle, body. Just like blood draw training we had a keeper stand to the side holding soybeans and do a continuous feed. We had a radiograph plate on an extension pole that we were able to put between her legs to get radiograph pictures of her hock. From previous training, the ostrich were able to step up onto a platform to get weights. By using this technique we could transfer it to stepping up onto a platform to take radiograph pictures of the ostrich's foot. This was important to get pictures of the entire foot instead of just the top half. To get radiographs of higher up on the leg, a platform was installed on the wall of the stall. This was a simple design to hold a radiograph plate so a veterinarian could get radiograph pictures while the ostrich was standing along the wall. Due to DAKL protocol, a zoological manager has to be in lead along with the veterinarian staff. Because of this, the trainers are able to position the ostrich to obtain radiograph pictures and then hand off the soybeans to the manager in lead. After the pictures were taken, we let the ostrich walk around the stall until she needed to get into position for the next radiograph.

## Sonogram

To prepare for a sonogram with our ostrich, the trainers introduced new items. For safety purposes, a shield was introduced to protect the veterinarian staff while they were focused performing the sonogram. The shield was placed towards the front, while the veterinarian was kneeling behind the ostrich. We also brought in gel that would be used for the sonogram to desensitize her to the colder and wet sensation. The ostrich did not have any reaction to these new items and the veterinarian was able to perform sonograms on joints and in the reproductive regions.

## Aspirate

After doing several other methods for diagnostic screenings it was decided to perform an aspirate of the swollen joint. We took several new approaches for this and decided to move training to a different location where training doors were previously installed. The trainers were able to position her against the wall and stopped her so her foot was even with a door that would give the veterinarian access from an outside position from the stall. In preparation for this, trainers positioned her and simulated the aspirate with a paperclip along with the numbing cream, which had to be applied 10 minutes prior. When she was in position, a numbing spray was also applied. The veterinarian was able to do one stick with the needle and aspirated fluid from the joint.

## Conclusion

In order to perform any of these diagnostics in the past, the ostrich would have been pressed against the wall, which could be a potential danger for them and the keepers. With some time, all of these behaviors were voluntary and we were able to rule out or gain knowledge along the way. After all ideas were exhausted, it was decided that Anna Belle would be a great candidate for surgery. She was immobilized without being pressed with another voluntary injection, which sedated her. She was then transported to the hospital where computed tomography (CT scans) were performed. She went in for surgery where veterinary staff did a bone graph on the metatarsophalangeal joint.

Our training techniques showcased that diagnostics can be retrieved by basic husbandry and medical training. Due to unforeseen challenges during the immobilization, a quality of life decision to euthanize was made. The necropsy reported that the bone graph would not have been strong enough to support her weight. As a result of all training efforts and lessons learned with Anna Belle, other ostrich in the collection have benefited from the training that was established with this case.

## Acknowledgements

Thank you to all of Disney's Animal Kingdom keepers and managers for assisting with training. Also thank you to the veterinary hospital staff for everything you do!

Blood draw

Radiograph

Sonogram

Aspirate

All photos by Megan O’brien

# Coolio and Friends!
# An Update about the Elephant Seal in the 'Burgh

*By*
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*Pittsburgh Zoo & PPG Aquarium*
*Pittsburgh, PA*

**Introduction**

Much has changed over the past two years for the partially blind elephant seal under our care. Since the presentation at the 2016 Memphis National AAZK Conference, Coolio has grown not just in size, but in confidence with his new surroundings. Plus, he has new sea lion and elephant seal companions!

The past year and a half has been an extremely important time in the life of our elephant seal. After his rescue and arrival in Pittsburgh in 2014, he resided in one of our large indoor pools. There he recovered, acclimated to human care, gained trust in his keepers, and learned critical husbandry behaviors. Then July of 2017 put our past 3 years of training and trust to the test, and changed all of what Coolio knew. Coolio moved into his new 250,000 gallon outdoor pool. In October and November of 2017 Water's Edge welcomed three new pinnipeds that would be companions for Coolio: Nav and Piper, a breeding pair of California sea lions, and Ellie Mae, a rescued female Northern elephant seal. We soon learned we would have new challenges to face with daily husbandry, training, introductions, staffing, shifting, diving, and visitors, but our Water's Edge team was up to the task.

**Brief Natural History and Zoological History of Elephant Seals**

Named for the large proboscis that adult male Northern elephant seals sport, these phocids or true seals can weigh up to 2000 kg (4,500 lbs.) for mature males and 600 kg (1,500 lbs.). They are only dwarfed by the Southern elephant seals that can grow to twice that size. Northern elephant seals reside off the coast of California, with males traveling up to the coast of Alaska and females traveling as far north as the coast of Canada. Elephant seals are solitary for most of the year with the exception of molting and breeding seasons, where 3 month spans in April-June and November-January, thousands of elephant seals congregate on the beaches.


Figure 1-
Mating Northern Elephant Seals
©Mary Ann McDonald

Single pups are born in November and nursed for only a month with high fat milk. After they are weaned, the pups are left to fend and learn for themselves over the next year in the rookery. After the year of learning they join the adults in leaving the rookery for the open ocean, where they hunt during dives of depths to 1150 m (5085 ft) and a length of 2 hours. In the 1800s, Northern elephant seals were hunted almost to extinction after whale blubber became scarce. Only about 100 remained. The Mexican government made it illegal to hunt them and their numbers have been climbing back to a stable population of over 120,000 individuals.

The history in zoos and aquariums for this species is difficult to research. Most individuals were Southern elephant seals that were kept from the early 1900s through the 1970s. These seals were captured from the wild and most did not live passed the age of 10. There has only been 1 recorded birth and the pup did not live to be older than 1 year. Accessing these records, if they still exist, is next to impossible. Only a few rescue elephant seals have been taken in by U.S. facilities, but all have passed away due to complications of their injuries.

The individuals that were kept were extremely popular with visitors leading to many historical photographs that are easier to find. But these images do not provide much of the husbandry information that our facility needed to have an idea husbandry needs, let alone how they interacted with members of their own species and with other species. Field research on Northern elephant seals is also rather limited due to their solitary nature in the open ocean, diving extremely deep depths for most of their time. Because of these challenges, we as a team are making the husbandry manual on Northern elephant seals.

**Coolio's History**

Coolio was found by beachgoers on Pebble Beach in Crescent City, California. The Northcoast Marine Mammal Center, responded to the call of an injured seal. They found him completely unresponsive, extremely malnourished, and suffering from severe trauma to his eyes and head due to shorebirds. This trauma left him without his left eye and damage to his right. He weighed only 63 kg (140 lbs.) when he should have been over 4 times that weight as a yearling pup.

Figure 2 –
Coolio at the time of rescue
©Northcoast Marine Mammal Center

Because of these injures he would never recover full sight. Coolio was deemed a non-releasable seal by the U.S. Fish and Wildlife Service. Contacts then went out to see if any facility was interested in permanently housing this male seal that has the potential to grow into a massive marine mammal. The Pittsburgh Zoo & PPG Aquarium agreed to provide him with a home and he moved to Pittsburgh in April of 2014.

Figure 3 –
Coolio and keeper Megan Paluh during the transport
©Northcoast Marine Mammal Center

Figure 4 –
Coolio learning to target with a target pole
©Paul Selvaggio

After a long acclimation period, Coolio began to settle in. Our Water's Edge team uses positive reinforcement for our training program and Coolio responded wonderfully! The first behaviors were targeting on a pole target and follows from station to station in the pool. These behaviors took a while to complete, as with any green/new animal to training, but also due to his nervous behavior with new situations and stimulus. After the basics were completed, more advanced behaviors such as flipper presents, especially on his blind left side, were attempted. As Coolio's confidence in training grew, his overall nervous behavior began to diminish. Enrichment and the use of environmental enrichment devices also helped to build confidence and ease the transition into new spaces and pools.

Figure 5 –
Shifting to the outdoor holding pool.
©Amanda Westerlund

**The Big Move to the Big Pool**

After the renovations of our 250,000 gallon saltwater pool ended in June 2017, it was finally time to begin the plans for Coolio to make the big move into the outdoor pool. Until that time, he had been shifting in and out of our indoor pool and outdoor holding pool reliably. He had been given the chance for new noises, weather conditions, sunlight, and exposed to diving sounds (hydraulic power scrubbing, bubbles, voices in the water, ect.). Coolio was a ready as he could possibly be.

Figure 6 –
Coolio the day of shifting outside into the 250,000 gallon pool.
©Amanda Westerlund

When his molting ended in July 2017, we made the decision he would be shifted out on a Tuesday. This would allow for some adjustment time before a heavier visitor count on the weekends, since he had never seen people through acrylic before. Staff used blue painters tape to make lines and patterns on the underwater acrylic tunnel and gallery windows to limit any collisions that would occur with his limited sight. Signs were also made asking the public to please refrain from hitting the windows.

The day of the big move everything went extremely smooth. Coolio handled the shift well and entered the water much faster than we anticipated, in less than 5 minutes. Coolio was, as expected, overwhelmed by the size of the pool. This pool was over 25 times the size of the pools he was accustomed to. Keepers and interns were on site at all times watching him, and visitors, during the day for the next two weeks. Visitors did not always understand his vision loss and on edge nature in his new area and would hit on the windows, causing Coolio to become more nervous and haul out. During feeding/training sessions, we would utilize interns to ask to public to move away from windows and to be as quiet as possible. This helped a great deal to keep the sessions positive.

Figure 7 –
Working to keep each session positive.
©Amanda Westerlund

**A Long Summer of Setbacks**

At the end of the two weeks in the new pool and what seemed like a good transition, Coolio suddenly went off food entirely. We had expected this initially, as this was his normal response to new situations, but not after two weeks of positive interactions. Over the course of the next 3 months we had to go back to the beginning with building trust again.

Coolio was the only animal in this pool, so we were able to leave recorded amounts of fish in slide out areas to make them positive again. This also helped to keep his digestive system active to avoid any stomach shrinkage. We also tried to keep Coolio active and swimming at least part of his day, since he was choosing to stay in one corner away from visitors and keepers, rarely diving. To accomplish this we would scatter small amounts of herring in the pool. We used any time we had to remove fish from the pool with a net or clean the pool as a chance Coolio would haul out. The keeper cleaning would stop netting/cleaning when he hauled out and a second keeper would enter the area with his food about a minute to two minutes after the cleaning stopped. Coolio would be able to hand feed almost ever try after a week, associating the keeper with being positive again.

Figure 8 –
Coolio with one of our signs asking the visitors to not tap the acrylic windows.
©Amanda Westerlund

Figure 9 –
Coolio hauled out
©Amanda Westerlund

Figure 10 –
Coolio in the outdoor holding pool
©Amanda Westerlund

We began entering his area through two different doorways and slowly began to increase the amount of herring and capelin for each session. Because Coolio was not receiving squid (it is his first food type refused and also mostly water), we started injecting freshwater into each herring for hydration. Pinnipeds receive their entire water intake through the fish that they eat and he was eating minimal amounts. After the 3 months of altered feeding styles, Coolio finally began to come to session on his own when we entered the area.

We started formal training again with the basics: “open,” “target,” “whiskers,” and his right “flipper.” As a team we picked each week which behaviors to add back into Coolio’s training schedule and worked only on building a positive relationship again. We would only enter for a session if all the conditions were setting him up for success. We continued to utilize our interns to keep the visitors quiet and away from the windows as well. By the end of autumn Coolio was back to his eager self, much to our relief. Today, he is now one of our most reliable animals for sessions, training, shifting, and engaging with enrichment!

**Nav, the Sea Lion, Returns to Pittsburgh**

Now that Coolio was finally fully adjusted to the new outdoor pool, our plans for adding companion animals could start. Our curator had already made plans with our contacts at the Georgia Aquarium to bring back Nav, a male California sea lion, who Coolio had met in the summer of 2015. We had picked Nav for a few reasons: he was typically a submissive animal with other pinnipeds (often displaced on the deck by harbor seals), he had met Coolio previously with no aggression, and Nav was available. In October 2017, Nav moved from the Georgia Aquarium to Water’s Edge.

Figure 11 –
Nav, California sea lion
©Amanda Westerlund

Sea lions were a big change for our keeping team. Our experience with pinnipeds until this point had been just Coolio, who was slower in nature when compared to a sea lion. Coolio is a large animal (over 800#), but Nav at only 500# felt massive and intimidating when standing next to him. During his quarantine period, we learned how to work with this quick species free contact. Gating and shifting positively was our number one priority. Nav thankfully was very accustomed to new people, and new trainers, working with him. He helped to show us how to reinforce for the best results, how to communicate with him, and how to plan our training sessions more effectively ahead of time. He also helped us to think differently about training, in many ways that helped us work with Coolio more effectively too! We learned that sea lions respond to our over the top enthusiasm with better responses. Coolio began to respond better with the increased enthusiasm in each session too.

**Ellie Mae, the Female Elephant Seal, Comes to Pittsburgh**

When we neared the end of Nav's quarantine period, we got the official word that Pittsburgh would be headed out to the Marine Mammal Care Center in Los Angeles to bring home a non-releasable female elephant seal. This female seal was cross-eyed. As a result she had failed her test to be released with their other elephant seal weaners. The first week of November 2017, staff headed to Los Angeles to work with her before her transport back to Pittsburgh.

Figure 12 –
Ellie Mae at the Center
©MMCC

Figure 13 –
Ellie Mae at the Center
©MMCC

Thankfully, this female seal we now called Ellie Mae, had a much less traumatic start in life. While she had stranded when she was severely malnourished and was cross-eyed, she had never lost interactions with other elephant seals or sea lions. When Coolio was rehabilitated, his daily care was much more extreme, causing him to be housed alone. His daily medicating for his injuries was stressful, but necessary. Ellie Mae also had a much more outgoing and feisty nature.

Figure 14 –
Ellie Mae shifting
©Amanda Westerlund

Figure 15 –
Ellie Mae interacting with enrichment
©Amanda Westerlund

Ellie Mae came home to Pittsburgh in November 2017, and only took a week to adjust to hand feeds in our indoor holding pool. During her quarantine period she did develop seal pox, a typical virus found in wild seals and sea lions. The virus normally activates during and after stress, which her move to Pittsburgh most likely triggered. Luckily, seal pox treatment just requires time and easy, preventative cross contamination measures for the keeper staff. Our full keeping staff was able to continue to work with Ellie while continuing to work with all of our other animals at Water's Edge.

Our new seal quickly showed us her behavior was very different than Coolio. She has more of a typical elephant seal demeanor: vocalizing if frustrated, attempting to come very close to staff with food, and following staff after sessions are ended. We adjusted how we worked with her and found how to keep her sessions positive.

**Coolio and Nav Introductions**

After Nav's short time in our outdoor holding pool, we introduced him to the large outdoor pool and Coolio. Coolio's reaction was not one that we expected, but had planned for. Coolio chased Nav around the pool! By the end of the day Coolio had become comfortable again. The introduction sessions were kept to half days until both seemed comfortable, then full days, and then finally overnight. Surprisingly, Coolio was not nervous of Nav even when Nav came out on deck. Both would station at just about every session without issue.

Figure 16 –
Coolio and Nav training with keeper Megan
©Amanda Westerlund

**Hello Piper!**

At the Pittsburgh Zoo & PPG Aquarium, our Kid's Kingdom department also cares for California sea lions. One of their sea lions, a young 5 year old female named Piper, needed to be placed at a new location. Her father, Hawk, was also housed in Kid's Kingdom. Kid's Kingdom keepers had to keep her and her father separate, and rotate the two in with their other sea lions. The decision was made that she would be a good breeding match for Nav, as well as a good companion for Coolio. Piper moved up to Water's Edge in the middle of November, just about 2 weeks after Ellie arrived. The number of pinnipeds in our care had jumped in the span of a month from 1 to 4!

Figure 17 –
Piper and Nav
©Amanda Westerlund
Piper was introduced to Nav first then to Nav and Coolio in the large outdoor pool

at the same time. We were able to give them both the public outdoor pool and our outdoor holding pool for extra space. This also allowed Coolio to have an escape from the two sea lions. Piper investigated Coolio for the first day, bumping him with her nose on his back. Coolio reacted briefly with an open mouth, giving him time to swim quickly away.

**Ellie Mae Explores the Outdoor Pool**

After Ellie Mae's medical issues concluded in June 2018, our team shifted Coolio into the outdoor holding pool by himself. We then shifted Ellie Mae into the large outdoor pool. From December through June we had been introducing her to Piper and Nav in our indoor holding pool, allowing her some time with both sea lions. The introductions went great. Ellie learned how to stand her ground with both sea lions and all three learned their personal space. After Ellie shifted into the large outdoor pool, she was nervous. The visitors at the underwater tunnel and windows did not seem to startle her, but the visitors at our surface windows did. We used the same technique that we did with Coolio: using our interns to have the public move away from the windows during sessions. After a month she was shifting inside and back out again!

Figure 18 –
Ellie Mae vocalizing at Piper and molting in the outdoor pool
©Amanda Westerlund

Thanks to the increased sunlight outside, Ellie also began to finish molting rapidly. We moved her back inside when she was almost finished and allowed Coolio time in the outdoor pool again. We then turned our focus on reliable shifting for all the pinnipeds to allow us to return to our multiple dives each week. We would keep each dive day positive, changing who shifted where and provided them with enrichment.

Figure 19 –
Piper and Nav resting in the outdoor pool
©Amanda Westerlund

**Introducing All Four Pinnipeds**

As of the middle of August 2018 we have not introduced all four pinnipeds in the same space. Coolio and Ellie Mae have been introduced with a barrier between them. We are in the final steps of having Ellie Mae explore the outdoor holding pool, the last space she needs to learn. When she is comfortable and shifting inside and outside once again, we will introduce all four and allow them to have our entire space: indoor holding, outdoor holding pool, and the big outdoor pool. They will be able to move to or away from animals as they would like.

Figure 20 –
Coolio and keeper Amanda
©Nikki McNaughton

Figure 21 –
Coolio resting in the shifting doorway
©Amanda Westerlund

**Conclusion**

Over the past year our team and our pinnipeds have had one event filled year and a half! Our total number of animals for our department expanded from five to eight, gaining two sea lions and an elephant seal, along with our previous elephant seal, two sea otters and two polar bears. Our team learned how to work with a new species and how to work with an animal that went through major setback in trust. We learned how to multitask animal changes, keeping up our records, creating new enrichment, and training goals while finishing two major exhibit renovations. Any now we have four confident pinnipeds and an even greater passion for what we do!

**References**


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# Asian Bull Management at Denver Zoo

By: Barb Junkermeier, Toyota Elephant Passage keeper.

Denver Zoo has a long history of managing elephants, caring for female Asian elephants (with the addition of one female African elephant in the 1980s) since 1950. In the early to mid-2000s, plans were being formalized to open a large, state of the art facility to manage bulls, a first for Denver Zoo. Construction of the 52 million dollar facility began in 2009 and lasted for three years with the opening of Toyota Elephant Passage on June 1, 2012. The two elderly female elephants, who were long time Denver Zoo residents, were relocated to the expansive ten acre exhibit to live out their remaining years with the addition of three male elephants from various facilities. These three bulls arrived between the years of 2011 and 2013, paving the new path of elephant care and management at Denver Zoo.

Bodhi arrived from the Columbus Zoo in 2011 as the first elephant to reside on site at Toyota Elephant Passage before opening. At the time of initial plans to introduce the bulls, he was 12 years old and weighed approximately 9,000lbs. He grew up in a herd dynamic until moving to Denver. Groucho then arrived from the Fort Worth Zoo in January 2012. At the time of introductions he was 47 years old and weighed around 11,000lbs. He is a very calm and confident elephant. He had been born in India and arrived in the United States when he was estimated to be 1 year old. He had been around other elephants in previous facilities but little was known about whether he had been around bulls. Finally, Billy arrived in 2013 from the Antwerp Zoo in Belgium. He was 8 years old at the time of introductions and weighed approximately 7600lbs. He is a very rambunctious elephant with a lot of energy. He had spent his first few years in Ireland with his family group then was housed with a male of similar age in Antwerp before moving to Denver.

Denver Zoo's goal since the opening in 2012 is to be a bull holding facility. With that in mind we wanted to develop a more advanced social program for our current residents and continue to strive to manage future unrelated males in this fashion.

How did Denver Zoo begin this process? The elephant team had many meetings about bull socialization to discuss all aspects of our goals, when and where did we want this to occur, which elephants would we want to start with, what emergency equipment did we need/require and how or when would we intervene, how many staff did we want present, what challenges might we encounter etc. We also wanted to let the elephant's behavior dictate how fast and long our introductions would last. During our meetings we had input from all pachyderm team members, veterinarians, and curatorial staff. Our initial plan was to start with Groucho and Billy due to individual temperaments but as we were about to get started with the first steps, Groucho went into musth. We then decided that instead of waiting for Groucho's musth to end we would start with Billy and Bodhi.

We set them up with howdies for several weeks where they had access to touch and interact with one another in adjoining stalls where, instead of the barns usual concrete walls, these areas were steel bollards with more open space. While this was a new level of interaction for them we wanted to see if, done daily, some of the novelty would wear off and they would begin engaging and interacting and presenting appropriate behaviors. After approximately 2 weeks we began to see Billy laying down next to the areas where they were able to touch and Bodhi would be playing with him in return. At this point, we were confident in picking a day to let them join each other in the same shared space for the first time. (Figure 1)

On December 20th 2016, we proceeded with setting up the area surrounding the yard that was chosen for the introduction with all our fire extinguishers, fire hoses, air horns and buckets of food. We notified the vet staff and management and we closed the area to the public. Once everything was set up and keepers in place we let Bodhi out into the yard first. He was stationed with a keeper at the far end of the yard and then Billy's gate opened and he was able to join Bodhi if he chose to. Staff stepped back immediately and watched as they met one another fully for the first time. They calmly approached one another, they did not vocalize and showed appropriate behaviors between one another. (Figure 2) After about 30 minutes, we could tell by Bodhi's behavior that he was disengaging with Billy and we separated them. We continued with these introductions on a daily basis. Because these two were getting along so well and with weather in the winter in Denver being a factor, we continued managing them together in the barn as well. As time progressed and we could see that the two were developing a stronger relationship than we had expected, we opened up more space for them outside giving them access to different yards.

Roughly a month later, Groucho was finally out of musth and we started with howdies between him and the two young boys. Since we were seeing positive interactions between all three elephants in howdy situations we all sat down again to discuss our plan for introducing all three together. (Figure 3) It was discussed whether we should introduce them one at a time to Groucho, but having seen the interactions in the protected howdy scenarios, we opted to introduce Groucho to the pair of them. Again we set up all the safety equipment that we wanted on hand, had additional staff for eyes since this time we were going to be covering more space than our previous introduction with just the two young bulls, and prepared for our 47 year old to join the group.

When the gates were opened for the three to interact freely, they all acted appropriately towards each other, with initial greetings of trunks touching, investigating each other's mouths etc. (Figure4) this introduction lasted an hour. During this hour, Groucho was more interested in Bodhi than in Billy. Bodhi acted submissive towards Groucho, backing into him and allowing Groucho to touch him, vocalizing when Groucho approached him. Occasionally, Groucho would go off on his own and Billy and Bodhi would resume playing with each other. (Figure5) In the first couple of weeks of doing this regularly, we saw Groucho napping while the two young bulls were in the same space, even sleeping in the large mud wallow while Bodhi and Billy play sparred in the background.

While everyone did well together, our goal was not to have them housed together 24 hours a day, 7 days a week. Our plan became to house them together a few times a week, see how they do in different pairs with Groucho instead of them all being together and still making sure that they had some days per week where they were alone.

As time went on, we came across our first challenge, musth. Billy had not yet had a musth cycle so we were not sure when to expect his first musth to kick in but one day when shifting Billy into a yard to be shared with Groucho and Bodhi, Billy turned around and came back into the barn and faced Groucho for the first time. He immediately pushed his head against Groucho's and we knew something was different. We followed them to the yard and watched as Billy ignored Bodhi and went straight to Groucho who he sparred with. We decided to supervise and see how it played out for a bit but about thirty minutes later it was clear that Billy was not going to leave Groucho alone so made the decision to separate them.

A couple weeks later Bodhi went into his musth earlier than normal. We saw him focus in on Groucho as well so we made the decision to not put Groucho with either of the 2 young boys while they were in

musth. We did however want to see how Billy and Bodhi would react together while they were both in musth. Again we set up all emergency equipment and notified the vet team that we were going to put Billy and Bodhi together. They did really well, with more intense sparring but nothing that was overly aggressive or inappropriate for their state at the time. We continued with these introductions once a week to allow them an energy release during their musth, but not more often than that due to the intensity at which they were interacting. (Figure 6) Other challenges that we encountered were injuries that the young bulls sustained including a couple of injured foot pads and a hyper extended knee which all healed nicely.

When putting the bulls back together after Billy and Bodhi came out of musth in the early summer time, we saw a shift in the herd dynamics. Bodhi was wanting to hang out more with Groucho than Billy. (Figure 8) Bodhi would still spar with him but it was not as often or for as long. Groucho started to be more assertive with Billy and did not want Billy to be anywhere near him. We continued to see significant changes in their relationship when all three were housed together, Billy being required by the older two to keep a greater distance. Most recently though, Groucho came into musth in October and we again saw a change in the herd dynamics. Billy and Bodhi quickly resumed their initial bond and didn't seem to want to be near Groucho. While Groucho was never aggressive to them and didn't care to interact with them, his presence seemed to be a stressor for Bodhi and Billy so he was separated from the group for the duration of his musth.

Now, Groucho is back out of his musth and we have reintroduced him back into the group. We are seeing the same behaviors from them all as we did when we first started our initial introductions a year ago. The three of them are trusting one another again, doing demonstrations all together for our guests, and engaging with one another as they did in the beginning.

What we saw during all of our introductions was an increase in exercise and activity with all them, but especially Groucho. We also noticed that his and Bodhi's stereotypic behavior decreased significantly. We did see some unexpected increase in stereotypy from Billy that occurred while he was not with the other elephants but had visual access to them and he is continuing to be monitored for those occurrences. Another positive outcome is it seems that our guests seem much more engaged when they see numerous bulls interacting and playing with one another. We often see large groups of people gathered together to watch them.

Going forward, the Denver Zoo is excited to be involved with bull management and have hopes to increase our herd size, be involved in research opportunities, and be a resource for other facilities in regards to managing Asian bull elephants.


*Figure 1 Billy and Bodhi howdy*

*Figure 2 Meeting for the first time without a barrier*


*Figure 3 Groucho howdy with Billy and Bodhi*

*Figure 4 Meeting for the first time*

*Figure 5 later on first day*

*Figure 6 doing demos together*

*Figure 7 Billy and Bodhi sparring more intensely while in musth*

*Figure 8 herd dynamic change, Bodhi hanging out with Groucho more*

# Inception to Innovation: A Turquoise Dwarf Gecko Breeding Program

Jeff Bocek - Keeper - Herps & Aquatics - Brookfield Zoo - Chicago Zoological Society

## Abstract

The turquoise dwarf gecko, *Lygodactylus williamsi*, has recently been listed as a CITES Appendix I species and threatened with extinction. The Chicago Zoological Society made the decision to bring in a group of geckos to help the inception of a breeding program among AZA facilities. Knowing these geckos are small and fast, we began by planning the set-up with basic 3D computer designs and reaching out to others for information on husbandry. We used these designs to sell the project to management and the need for special enclosures and supplies. However, despite all of our planning, our geckos were still finding ways out of their enclosures and laying eggs in inopportune locations within. Through accepting defeat that our original ideas were not working, we were able to successfully contain and breed our new geckos. We achieved this by channeling our inner MacGyver and repurposing supplies already on hand. This paper shares how we planned for a new breeding program, the mistakes we made, and our inventive approaches to improving gecko husbandry practices; this includes enclosure security, design, and incubation techniques.

## Introduction

The turquoise dwarf gecko (*Lygodactylus williamsi*) is a small species of gecko from Tanzania (Figure 1). Their main habitat requirement is the screwpine plant, *Pandanus rabaiensis*, which they occupy almost exclusively. While having access to this plant in captivity is not necessary, in the wild they only inhabit areas where it occurs. The geckos are only found in a few small forests which make up an area about 40km² giving the geckos a very small range map. They eat bugs, fruit, and nectar from flowers. These geckos are sexually dimorphic with males being a bright turquoise blue while females are a greener coppery color. Sub-adult males will subdue their coloration to mimic females to avoid competition with the dominant male. They are a small species with a maximum length around three inches and a weight of about two to three grams. When babies hatch out of the eggs they are three centimeters long and weigh less than a gram. Due to their attractive color and diurnal behavior they have become very popular in the pet trade the last ten years leading to severe population decline. In light of their conservation status in 2016 The Chicago Zoological Society made the decision to bring in a group of these geckos to help the inception of a breeding program among AZA facilities (Species Survival Plan® (SSP)). Our goal was to be a major participant in the breeding and conservation of these small geckos. Due to their International Union for Conservation of Nature and Natural Resources (IUCN) critically endangered status, Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) I designation, small size, beautiful coloration, and active diurnal disposition; they will be an important species going forward for zoological institutions. To insure our breeding program had a solid foundation we began by researching both the natural history of the species and proper husbandry.

Figure 1: Male turquoise dwarf gecko, *Lygodactylus williamsi*

## Research

We began our research by reaching out to colleagues and other parties with turquoise dwarf gecko experience. We contacted other institutions including the Audubon Zoo and Virginia Zoo who had currently been working with this species. We scoured the web for scientific articles, web pages, and any web forum post mentioning turquoise dwarf geckos. While it is important to not take every piece of information from the web as 100% accurate a great deal of wisdom can be learned. However, the two methods that resulted in the most relevant information gathered were sending out a request for information over the AZA Lizard Advisory Group list serve and through joining a Facebook group dedicated to keeping this species of gecko. The AZA list serve provided a gateway and avenue to contact those outside of our network of colleagues and friends with different experiences than our own. The Facebook group also led us to a very detailed husbandry manual created by Frank Payne, from which we based a lot of our husbandry decisions. In our quest for knowledge we learned the importance of consulting with non-AZA institutions. We gathered a great deal of information we would not have received otherwise. As more is learned about husbandry all parties committed to conserving this species of gecko benefits. After compiling as much information as we could we began the design phase of utilizing this valuable information. It is important to add that this step is never complete. We are always looking to talk with likeminded enthusiasts to find new information that can help us improve the welfare of our animals and to provide husbandry practices more efficiently.

## Designing

Our first priority was to create a plan of how we were going to house the geckos and then where this housing would go. We needed to create a proposal which would include the logistics and cost of materials. We wanted to show as best as we could what this program would look like visually, but also financially. At Brookfield Zoo (run by the Chicago Zoological Society) the Herps and Aquatics department is spread throughout a number of animal buildings at the zoo. We decided to pick an area which was currently underutilized, had temperature and humidity control capabilities, and had access to a natural photoperiod via a door with a window to the outside. Our plan consisted of a goal for the project, a summary, diagrams, and a budget. The purpose of the plan was to convince

GOAL: To create appropriate environments and enclosures to breed critically endangered turquoise dwarf geckos. We must be able to house breeding adults and the corresponding young. To produce redundancy these enclosures can also support the housing or breeding of other species of geckos and amphibians.

management that funds and materials were necessary to run the program the right way. The better we could relay that message, the better chance we thought there was of receiving approval. One of the ways we tried to increase our chances of receiving our requests in the proposal was to plan it in phases. At most zoological institutions obtaining adequate funding, space, and staff time is difficult. Depending on one's organization, one or all three of these could be the limiting factor. Creating the project in phases reduced our initial asking costs which we anticipated would be one of our limiting

factors. At the same time, by creating the project in phases, we created escape hatches to not invest completely into the proposal. What if we were unable to breed the geckos? What if staffing was reduced and we were unable to continue the project? Instead of spending a lot of money right away we could see if this was a project the team and zoo wanted to continue long-term. We created two phases of our overall proposal with diagrams and budgets for each. We wanted to be conservative in regards to materials and costs but we tried to create as much flexibility as possible. We designed our enclosures and setup to be used by other species besides geckos. The ability to house other species allows the department and curator to have more flexibility in creating collection plans and doesn't waste materials if our breeding project did not work for the geckos (Figure 2).

SUMMARY: Create two shelving units with three shelves of enclosures each. The top two shelves will house glass aquarium while the bottom shelf will hold temporary housing for surplus animals or young. Each unit will be rigged with track lighting for thermal gradients, florescent lighting for UV, misting lines for water, and plumped for drainage. A centralized misting component will be purchased and support both units. (***Alternative Option*** Instead of two racks with glass aquariums and temporary plastic tubs only do one. Have the second rack house screen cages suitable for geckos and chameleons.) These units will be acquired in two phases as we already have many of the supplies to create the first unit.

The glass aquarium will be ExoTerra terrariums with a front opening door. A bulkhead will be installed to allow for easy cleaning and drainage. The temporary enclosures will be plastic Kingsford bins (***Alternative Option: Use smaller ExoTerra glass aquariums; more expensive***). Two large holes will be cut out of the lids and replaced with screen allowing airflow, light, heat, and misting access. One half of the lid may be open at a time to allow keepers access but with limited escape ability for the gecko. A bulkhead will be installed to allow for easy cleaning and drainage.

In total these two units will support 16 breeding/holding enclosures and 14 temporary enclosures. If we house geckos and they are housed in pairs this results in housing for 32 adult geckos and 28 juvenile geckos (or some combination of 60 geckos if paired).

To create our diagrams we used a program called Sketchup (Figures 3-7). Per Wikipedia; Sketchup "is a 3D modeling computer program for a wide range of drawing applications such as architectural, interior design, landscape architecture, civil and mechanical engineering, film and video game design. It is available as a web-based application, *SketchUp Free*, a freeware version, *SketchUp Make*, and a paid version with additional functionality, *SketchUp Pro*." For creating basic 3D diagrams it is a great free resource that keepers can use. All it takes is some time to learn the basics. The images this program makes can make a proposal by keeper staff look more professional.

Figure 2: Current gecko enclosures. Altered from original designs.

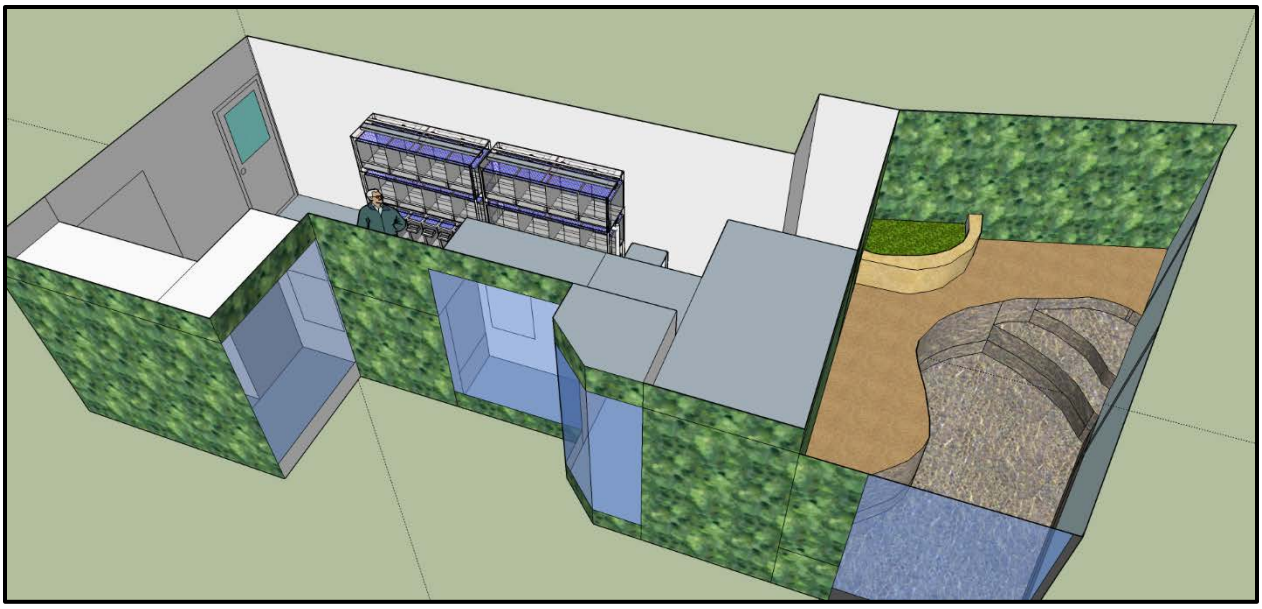

Figure 3: Herp area of Habitat Africa: Forest building at Brookfield Zoo. On exhibit and Off exhibit areas. Off exhibit area shows where gecko housing would be located.

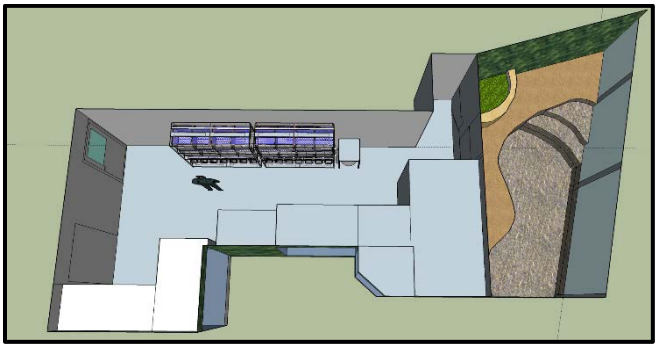

Figure 4: Top view of Figure 1.

Figure 5: View of working space off exhibit with proposal

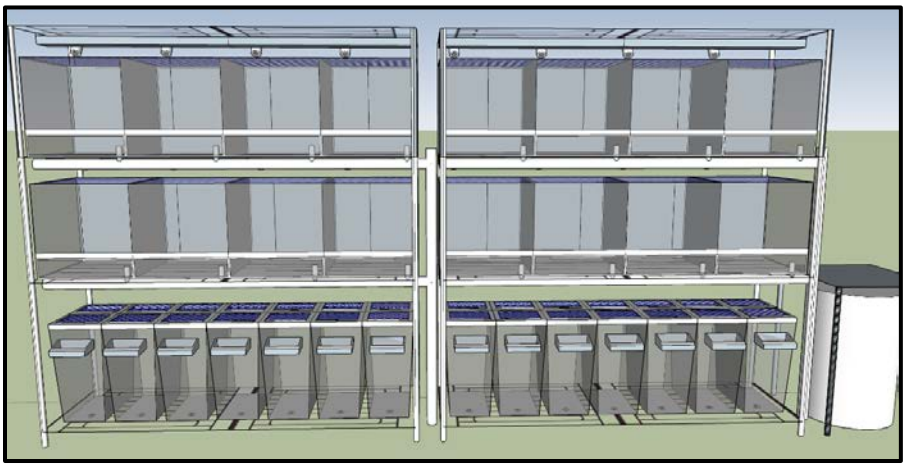

Figure 6: Phases 1 and 2 of turquoise dwarf gecko housing proposal.

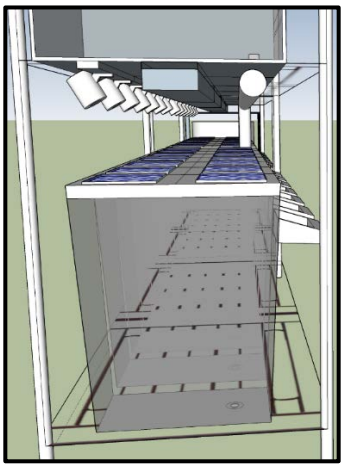

Figure 7: View of hatchling tanks.

**Enclosures**

Any plan involving live animals has a chance to go awry. Knowing this we tried to do our best to set ourselves up to succeed. To house our adult geckos we use eight Zoo Med Naturalistic Terrariums (18"x18"x24"). Each enclosure has a mister, a fixture with Zoo Med ReptiSun 10.0 UVB T5 HO bulbs above their enclosures, and a spotlight from a track light to provide a basking spot. The tanks were also plumbed with bulkheads and a gutter system for drainage and easy cleaning. To ensure the Zoo Med glass enclosures were escape proof a hole was drilled in the top of the door for a pin to be inserted to go along with the bottom latch ensuring two points of security for the door being closed. These are very fast geckos. When they are startled they tend to bolt or drop to the ground and then run. Due to their setae they can also climb the glass of the enclosures. We had problems when we had to catch the geckos up to record weights or change pairs for breeding. The geckos would run out of the enclosure. We catch the geckos by placing a clear plastic container over them and pinning it against the glass. Then we can slide the lid up against the glass and onto the container (Figure 8). One of the ways we were able to reduce the escapes was by attaching clear barriers to the frame around the door (Figure 9). We used the plastic containers and lids from boxes crickets are delivered in. The lids were cut and then siliconed into place. When geckos try to run out the door they now hit the barrier and fall to the ground giving keepers extra time to react. The barriers are flimsy enough the geckos have a hard time hanging on to them but provide enough support to prevent them from running through. For the most part we had little problems housing our adults. However, hatchling geckos are much smaller.

Figure 8: Container used to catch and transfer geckos


Figure 9: Adult enclosure. Yellow arrow points to clear plastic flaps to keep geckos in. Blue arrow points to removable PVC egg laying sites.

Our initial plans called for using plastic Kingsford bins that were meant to hold charcoal, with some alterations. We cut out parts of the plastic lid and made screen openings to allow air, water from a mister, light, and heat in (Figures 10-13). We liked these bins due to their cheap cost, tall height, opaque sides to see inside, and half of the lid was attached to a hinge making it easy to open. The container was also seal tight. We used these containers for our first breeding season with mixed results. Geckos like to be as high as possible. This meant the hatchling geckos liked to hang out where we had to open the container. This let to escapes and very nervous keepers every time you had to open the lid. Due to the container not being totally clear and the geckos being so small it


Figure 10-13: First attempt at hatchling enclosures. Repurposed Kingsford charcoal containers with screen lids installed.

made checking on the gecko very difficult without opening the lid to find them. Overall the reasons for wanting to use these containers were sound but they did not work out.

After these did not work, we went to our backup plan using the same Zoo Med Naturalistic Terrariums the adults are housed in but at a smaller size of 12”x12”x18”. We made these escape


Figure 14-18: First attempt at hatchling enclosures. Repurposed Kingsford charcoal containers with screen lids installed.

proof by attaching the plastic lids to the frame around the door and using duct tape on the top of the enclosure where any gaps where seen in the framework of the tank. As hatchling geckos do, they made these escape-proof enclosures obsolete by escaping. We are unsure how they got out. Therefore we had to go back to the drawing board. We needed to find an enclosure to house the hatchlings that we could set up an automated mister on, let light and heat through, contain three centimeter geckos, all while being able to provide food in a safe manner. After further brainstorming we have been using our current setup of a plastic container from the Container store. The plastic containers provide seal-tight enclosures to raise one or two hatchling geckos. We made similar alterations to the lids as our first versions by cutting holes and siliconing screen on top. This time to avoid opening the lid to feed every day a hole was cut in the side where we use PVC parts and a small fecal tube to provide the food. Essentially it operates like a bank shoot where you can deposit money - only the keepers are depositing food (Figures 14-18). While the dangers are the same when you have to open the lid to remove the gecko, the day-to-day risk of losing a gecko is removed.

**Egg Laying**

Our initial proposal did not include breeding or incubation planning. We did not know enough husbandry specifics at the time to include these parameters. We knew our situation would likely be different from others we talked to. These aspects have been trial and error with us learning more of what works for *us* with each breeding season that occurs. Right off the bat, while the geckos were in quarantine, we discovered our first mistake. The female geckos love to lay their eggs in the ceiling tracks of the Exo Terra Terrariums. They provide a dark secure space high in the enclosure for them to lay their eggs. We solved this by placing foam window gap spacers into this track. To give the geckos egg laying sites we placed in plants and 12" PVC pipes standing at an angle for them to climb into. While the geckos occasionally would lay their eggs on the plants or in the PVC they also would lay them in the middle of the wall of the terrarium on the glass. This created some problems. First, we had to cover the eggs with a plastic container to ensure the eggs were protected (Figure 19). There is a danger of parents eating the hatchlings. While this worked, the geckos lay clutches about every 20-30 days. If we leave a pair together for a few months having all of these additional containers in the exhibit would be problematic. Another problem was we could not control the temperature of the eggs. This species exhibits Temperature Sex Dependence (TSD), where the sex of the young is dependent on the temperature at which the eggs are incubated. Hoping to contribute to an SSP program, we wanted the ability to control the sexes. After reading about how Frank Payne uses floral tubes attached with

Figure 19: Egg glued to glass with plastic cover over it with hatchling.

Figure 20: Removable PVC pipe set up for incubation with hatchling.

Velcro to the wall of his enclosures, we tried something slightly different. We siliconed a PVC coupling to the enclosure wall and then placed two 3" pieces of PVC into either end (Figure 9 and 20). This has worked great. When the geckos lay the eggs in the pipe they can be removed and placed into an incubator. When a flashlight is put to the PVC there is enough light to candle the eggs as well. To guarantee the geckos lay their eggs in these tubes we have to place the PVC pipes into the enclosures before the female is introduced. We also do not overfill the enclosures with plants or other likely places they could lay eggs. This also helps when geckos are needed to be removed from their enclosures because there is less furniture in the way.

**Breeding Results**

In our two breeding seasons, we have tried incubating eggs a number of different ways. By force we incubated our first clutches in the enclosures. The eggs were glued to non-removable parts of the enclosure. While most of these eggs hatched, they were all males. Based on our research we found information stating average daily temperatures of 70-76 F produces females, 78-81 F produce both, and temperatures of 83 and above will produce males. Due to our heat lamps turning off at night our eggs received temperature swings to create these average daily temperatures. We suspected our geckos that hatched had average temperatures around 80 F. As with most husbandry aspects there are multiple ways of doing things right. Turquoise dwarf geckos have both been bred with and without nighttime temperature drops. After these clutches hatched our emphasis was trying to create easy incubation practices that would produce females, since we already knew how to produce males. The next incubation method we tried was to incubate eggs at a constant 74 degrees. This resulted in geckos dying in the egg and one dying after hatch. While we don't know the exact causes for these results the decision was made to move eggs that were currently being incubated at 74 degrees to 80 degrees in hopes this would result in successful hatches no matter the sex. The three eggs we did this to all resulted in successful female geckos. We went from hatching only males to only females; granted with a small sample size. We thought we had accomplished our goal.

Our next breeding season we tried to incubate this same way. We incubated at 74 degrees for the first month and then at 80 degrees for the remainder of the incubation period. Unfortunately, our results were mixed; both males and females were hatched. Due to our small sample sizes, none of our results are statistically significant. However, since we were not getting 100% females, we will make adjustments for the next breeding season. Aside from our sex ratios, an area for improvement is getting all of our fertile eggs to hatch. The percentage of fully formed geckos dying in the eggs is high. We hope with improved incubation practices this will improve. To insure we continue to improve all of our husbandry practices we monitor breeding geckos and eggs to track fertility, sex ratios, post-hatch deaths, pre-hatch deaths, and incubation type. Once we have improved sample sizes we hope to create significant charts and graphs using Excel pivot tables to help us paint a picture of problem areas and where we need to focus (Figure 20).

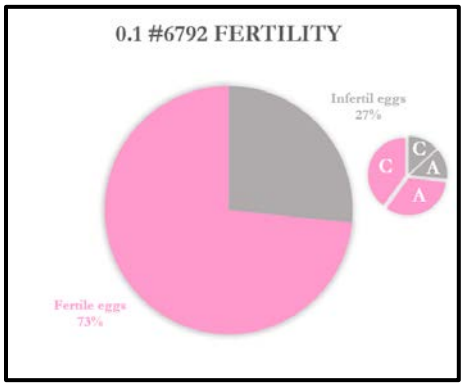


Figure 20: Fertility results for female #6792. Breakdown with two different males.

## Take Home Message

Designing and planning for a breeding project is the easy part. All it takes is patience, dedication, and foresight. We took the time to create designs to sell the project to management and the need for special enclosures and supplies. We wanted to do our best to place our team, the geckos, and our institution in the best scenario to succeed. However, despite all of our planning, our geckos still found ways out of their enclosures and to lay eggs in inopportune locations within. We had to be humble and accept defeat. Our original ideas did not work. To continue to advance a breeding project we found it takes creativity, humbleness, and will. We would not have been successful without the knowledge gained from others and if we had been unwilling to listen to suggestions. The will to always improve the husbandry and standards of the animal's welfare is key for overcoming the failures one will endure. We had to get creative in our solutions to improve our hatchling enclosures and to find ways of reducing our adults from escaping. While we thought we had solved our inability to breed females it turns out we have to go back to the drawing board and tweak our incubation practices. Creating a breeding project takes a lot of resources but is extremely rewarding. To help others in similar roles we encourage those in the midst of projects to spread their knowledge and tricks of the trade far and wide. In this light we hope our designs, successes, and failures can help other teams successfully run breeding projects of their own.

## Acknowledgments

Special thanks to the Chicago Zoological Society, Bill Ziegler and Andy Snider for supporting the implementation and continued success of the turquoise dwarf gecko breeding project. Congratulations and thanks to the entire Herps and Aquatics team for their hard work and vigilance caring for these beautiful geckos. Huge shout out to Frank Payne who has done an immense amount of the legwork in finding out the proper husbandry parameters for this species. Thank you to all those kind individuals who have responded to requests for information and proofreading with your stories, setups, and advice.

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# Hand Rearing: Assessments and Modifications for Greater Success

By Heather Samper and Kristal White

Moody Gardens

Galveston, TX

The Rainforest at Moody Gardens houses a diverse collection of rainforest animals. In recent years a number of rainforest mammals have required assistance to raise their young- from complete hands on nurturing to supplemental feedings to weight monitoring. Ideally, a dedicated trained nursery staff would be responsible for this type of care. However, due to our facility's small size, the biologists are responsible for hand rearing assistance. Hand rearing requires multiple people, excellent communication, detailed guidelines and records, flexibility with time constraints, and is not always a successful experience. Taxa specific husbandry manuals with detailed information on hand raising are ideal and would allow staff to create a solid foundation for developing a protocol specific to your facility. A variety of factors vary between facilities, such as diet or temperature, which may contribute to an offspring surviving versus premature death. In some cases, we were able to obtain hand rearing information from other facilities but in other cases hand rearing information was minimal or non-existent. Applying knowledge from one species to assist with raising another species may be the only resource available, yet it is sub-par husbandry. After each offspring no longer requires supplemental care, our records and data are compiled and reviewed so the successes and failures can be modified to improve our protocols for each species. This presentation will discuss hand rearing experiences with pygmy slow loris (*Nycticebus pygmaeus*), Rodrigues fruit bat (*Pteropus rodricensis*), prehensile tail porcupine (*Coendou prehensilis*), and a common vampire bat (*Desmodus rotundus*).

**Introduction**

The Rainforest at Moody Gardens in Galveston, Texas houses a diverse collection of rainforest mammals- from rodents to primates and hoofstock to carnivores- that are cared for by nine biologists, which account for primary, secondary and swing roles. Our mammal collection has grown over the years and a few species did have offspring, but there was no need for staff to intervene as infants were inaccessible- sugar gliders (*Petaurus breviceps*), vampire bats (*Desmodus rotundus*), and Prevost squirrels (*Callosciurus prevostii*). In 2006, our first mammal infants that biologists could access were born- 1.0 pygmy slow loris (*Nycticebus pygmaeus*) - and in 2008 1.0 prehensile tail porcupine (*Coendou prehensilis*) was born. Both females appeared to be attentive mothers and offspring thrived. Then they produced more offspring, and biologists began comparing weights from previous offspring and taking notes on body language and behaviors during pregnancies, thus compiling information on what was normal for these two mothers of these two species. But sometimes even the best mothers experience setbacks and keeper staff needs to intervene or assess welfare and protocols for infants and breeding pairs. Hand rearing is important because the life of an infant and in a broader sense, a species, is at stake. Hand rearing can range from complete hands on nurturing to supplemental

feedings to weight monitoring. For four species of mammals at the Rainforest at Moody Gardens, the biologists assisted offspring with each type of hand rearing, which will be discussed in this paper. Taxa specific husbandry manuals are a wealth of information yet sometimes lack specific information on how to accomplish more than just monitor the weight of an infant and provide growth charts from a few individuals. When an infant plateaus in weight gain or loses weight, staff has to make decisions quickly and sometimes with no direction on how to raise a particular species. Reaching out to other facilities that house this species can be helpful but takes time. Facilities we reached out to sometimes took days before responding or had minimal information to enhance what our staff was already doing. We look forward to providing information to institutions and management programs on what our facility has learned from hand raising these four mammal species so others can collaborate and more concise information can be readily available.

**Pygmy Slow Loris (*Nycticebus pygmaeus*)**

In October 2004, Moody Gardens acquired 1.1 pygmy slow loris. This breeding pair was 8 years and 4 years, respectively and had no previous offspring. While at Moody Gardens, the pair produce nine offspring. On a cold morning in late March 2006, one male offspring was found on a perch in their outdoor exhibit. He was brought inside and warmed up before returning to mom in a temporary indoor cage at the aquarium. Upon searching the outdoor enclosure for another baby, it was found on the ground deceased. Mom nursed and cared for this young offspring quite well, despite it being her first birth. Daily weights of the infant were obtained each morning. The baby was weighed twice daily until day 11, every other day until day 130, weekly until day 176, then monthly after six months of age. Four staff members cared for mom and baby for the first two months.

Knowing that the pair are successful breeders, a training program began so prenatal and postpartum care could be less stressful. Weights were obtained on a weekly basis, tactile was introduced so abdominal palpitations could be done, and drinking from a syringe was trained to deliver pedialyte and extra fluids to mom in the days following a birth. The new training program allowed for the development of a new pregnancy weight chart, which would be instrumental in determining a more accurate due date for future offspring, and allowed mom more tolerance of keepers postpartum. In March 2008, mom gave birth to twins in the month we were expecting them. However, twin A died on day one. On the fourth consecutive day of no weight gain (day 21) for twin B, supplemental feedings once a day with Similac formula began. On the morning of day 23, discharge was noted from the right eye. Later that day mom refused to take baby and carry it. On day 24, discharge was noted in both eyes in the morning and the baby was taken to the vet shortly thereafter. Cefalexin was given at the vet and prescribed daily, and glutamine powder was mixed with the Similac for the supplemental feedings. Mom, again, was rejecting baby and she was found deceased at the end of the day. Environmental factors of the off-exhibit, unsterile room most likely led to infection and subsequent cause of death (sepsis) for both infants. Four staff members cared for twin B, three of which were the same as the 2006 baby.

The loris pair was evacuated to another zoo after Hurricane Ike devastated Galveston Island. While housed there for four months, the two biologists stationed at the zoo continued their normal training program, which included weekly weights for the female. Both these biologists noticed a small weight gain and began to wonder if the female was pregnant. One of the zoo vets performed two ultrasounds on LuYen during our stay but nothing conclusive could be determined from the procedures. After returning to Moody Gardens in January 2009 the pair was housed at the education building. On 13 May, she gave birth to a single male. It's interesting to note that all her previous births were twins. Could this pregnancy of a singleton correlate to the hurricane in September 2008 and the subsequent stress of being relocated to the zoo? Since we separate mom and dad for safety reasons after the birth of offspring, mom and infant were transferred to a vacant office at the aquarium. The baby was weighed twice daily. Left eye discharge noted on day four with inflammation noted in the afternoon. On day five mom's abdomen was very wet, possibly from licking, and did not subside as days progressed. On day six the infant had weight loss and was diagnosed with conjunctivitis and prescribed medication. The baby plateaued at this weight for two days before another weight loss. On day eight the skin appeared to have a rash- red blotchy skin on his arms and legs. The vet prescribed Clavamox for an infection and advised starting supplemental feedings. Despite antibiotics, supplemental feedings, increased room and brooder temperature, the baby died at the end of the day on day nine. The female completely licked all the fur off her ventral abdomen in the days after the baby had passed away. It took several months for it to grow back. Three staff members cared for this baby, two were the same for both previous births.

After the death of three loris infants all less than 25 days old and 44g, staff decided to revamp the postpartum care. By utilizing the pregnancy weight data, could we determine a more accurate due date so the area mom was housed in could either been cleaned just before giving birth or she could be moved to a more clean and temperature controlled environment. Yes! What staff would be caring for mom and babies so there was less communication breakdown and more consistent care? What environmental factors could be controlled to provide a more successful development after birth? What information can be gathered now so staff can make a protocol when infant weight plateaus or takes a loss? Due to the significant importance of this species and their successful breeding, some major changes needed to occur to ensure healthy and viable offspring.

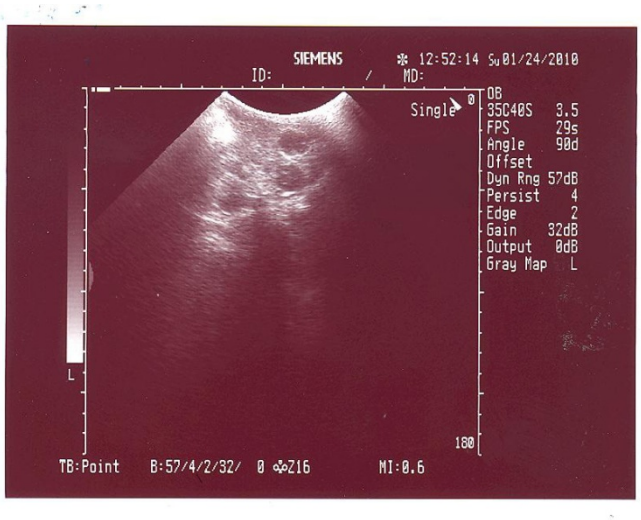
Protocol changes included a dedicated, newly remodeled room in the education building that would act as a nursery. While the ventilation was connected and controlled to the back half of the building, there were outlets in the nursery where a brooder, heat lamps, and a space heater could be set up safely and securely. The goal was to have two flight cages in this room. The pair could remain together until babies were born, then the male would be removed for safety reasons and placed in the adjoining cage so he could still be within sensory range of his mate. The thermostat could be raised slightly (to 78°F) without making the education staff too uncomfortable and the nursery ambient temperature would try to maintain 82°F. A small space heater in the room, heat lamp on the side of the cage, and a transportable brooder made from a cooler would be placed inside the cage with towels and perching leading into it. The space heater would provide a warmer room temperature and the heat lamp and brooder would

provide more direct heat source if mom chose to utilize them. Our research into this species' infant needs revealed that babies cannot thermoregulate until two weeks of age; so the added multiple heat sources were necessary. The vet requested tincture of iodine be applied to the umbilical cord and base for seven days to keep the area clean which is where most likely all previous infections have entered. The vet also wanted to disinfect the room and perching regularly with betadine. Personal protective equipment (PPE) for the biologists was procured- mask, gloves, boots and cloth cover (poncho was inexpensive and easy to disinfect). Supplemental feeding supplies were also procured- Esbilac low iron milk, syringes, puppy/kitten bottles and nipples, dedicated bowl and utensils, distilled water (for any formulas) and a gram scale noting down to a tenth of weight. For mom, RODI water, Pedialyte, and a lixit were procured. A water bowl could be a potential for drowning and adding Pedialyte to replace electrolytes from mom would also be helpful. All of the items were stored in a large Tupperware container and were only to be used for the pygmy slow loris babies to reduce the risk on contamination. The nursery basically turned into a quarantine area. Biologist care was decreased to two, both of whom had experience not only caring for the pair, but also assisting with the previous infants. Clavamox would be on hand and transferred to the nursery after a birth so it would be more accessible if needed. Supplemental feeding sheets were printed along with copies of daily weight forms and stored in a pygmy slow loris binder that accompanied the Tupperware of dedicated supplies. The vet would also be notified if a baby plateaued in weight or lost weight for three consecutive weights (morning-afternoon-morning or afternoon-morning-afternoon). Our hope was that intervention sooner than later would give baby a fighting chance. For an animal this small (birth weights are ~25g), infection can quickly turn deadly, as we've discovered. Weight loss or a weight plateau can be contributed to several factors such as over-nursing and not being hungry, which means not as much milk consumption; poor milk quality from mom; limited milk accessibility (not all nipples produce the same amount of milk); sibling competition; infection. Now equipped with better information and a plan in place, the staff felt more confident in providing a healthy environment for the loris babies and supplemental biologist care if necessary. We constantly evaluated our success with the species and made adjustments to their care accordingly.

Icarus and LuYen were reintroduced late May 2009 and by the first week of June, copulation and breeding behaviors were observed multiple times. Training and weighing continued as the pair was moved to different locations around property to accommodate the major remodeling from the 2008 hurricane. More breeding behaviors and copulation were observed in September 2009 and in December an OB/GYN was contacted to do an ultrasound on LuYen as we suspected she was far enough along in a pregnancy to detect a fetus. On 23 January 2010, Dr. Michele Blackwell from the local hospital successfully performed an ultrasound at Moody Gardens while the female was lightly restrained in a towel. A fetus was confirmed, as seen in Figure 1. Actually twins were confirmed and this was also the first successful pregnancy detection via ultrasound in this species. Due to fetus size, Dr. Blackwell estimated mom was in month two or three of her six month pregnancy. The nursery at the education building was completed and the pair was transferred to their new home on 1 March 2010. On 22 March 2010, twins were discovered and our new protocols were initiated. The male was transferred to the next cage. Heaters and footbaths were setup and biologists donned PPE to examine the

twins. Each baby was removed from mom, weighed, examined, and an opposite foot was dyed with blue or green food coloring for easier identification. Weights were recorded in the new notebook and the vet and tech were notified of the new arrivals. The two biologists from the previous infant birth became the exclusive caretakers of the lorises- dad, mom, and the twins. Following all our new protocols, the only problem encountered was maintaining a constant warm room temperature. Temperatures fluctuated from 75-83˚F. After 14 days, the twins were able to thermoregulate themselves and we did not see any signs of infection. Were the twins out of danger and staff able to call this a success? Not yet. The twins needed to reach day 30 and weigh over 50g for staff to be confident an infection would have manifested by then. At day 30 with weights of 72g and 74g, staff breathed sigh of relief and felt the new protocols were successfully implemented. The fraternal twins were thriving after a year and it was time to start finding new homes for them.

**Figure 1: Pygmy Slow Loris Ultrasound**




After all the remodeling from Hurricane Ike, the rainforest finally re-opened in May 2011. The pygmy slow loris pair had a new exhibit in the rainforest entry and on 14 June 2011 they had another set of fraternal twins! The protocols from the previous birth were implemented but with one minor change. The male was transferred to the nursery so mom and twins could remain on exhibit. The top ¾ of the exhibit window was covered with butcher paper to give mom and twins a little more privacy, as these were her first babies to grow up on exhibit. The two biologists who cared for the previous twins also cared for these twins. Temperature for the first two weeks fluctuated slightly but not as much for the previous twins housed in the nursery. Thus far these fraternal twins seemed healthy. After 30 days and weights over 50g, the staff again felt confident the twins were free of infection and this was another success following the loris infant protocols. The twins thrived and eventually both male offspring (from this and the previous pregnancy) were shipped to other facilities. We kept the two female offspring, introduced them, and housed them together so the male/female pair could be together again. Sadly, this would be the breeding pair's last offspring as LuYen passed away in October 2012 and her mate passed away eleven months later. Their demeanor, eagerness to learn, and

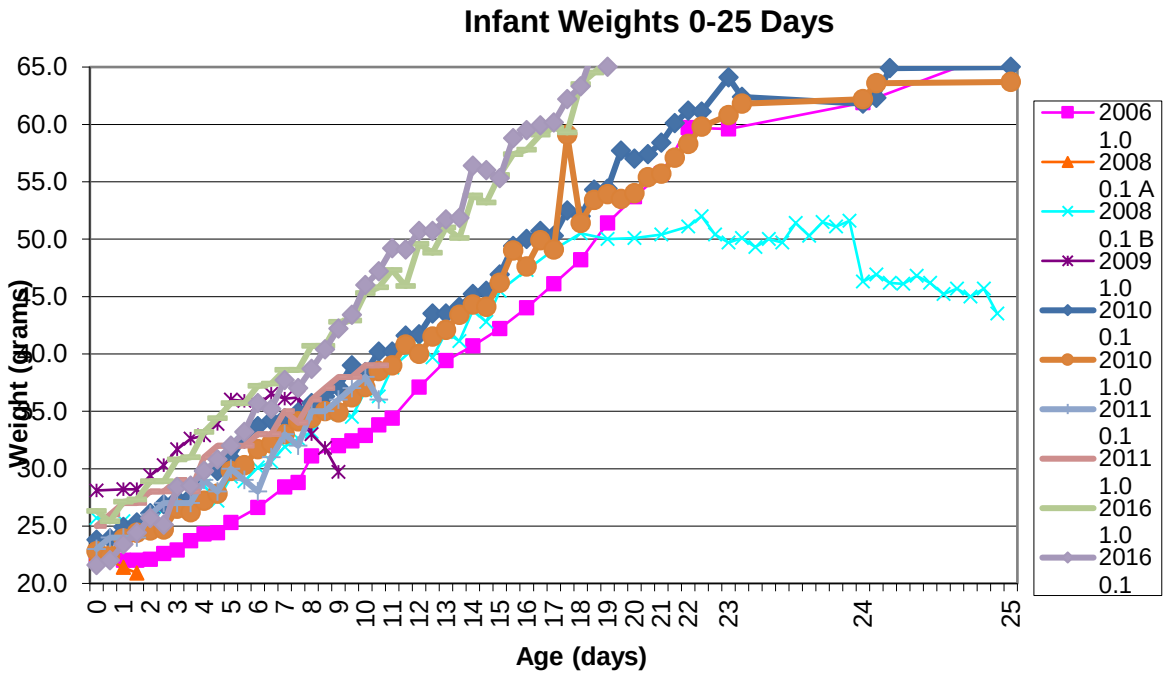
constant patience with keeper staff was instrumental in learning about this species and their young.

On 10 September 2015, the rainforest received a three-year-old male pygmy slow loris, Roach. The goal was to house him with one of the sisters and after she got pregnant and gave birth, he would be housed with the other sister in hopes of getting her pregnant as well. Initially he was introduced and housed with the older sister, Blackwell. The introduction took a minor setback after he attacked her but with creative modifications and a few more weeks of visual contact and limited physical contact, we tried introductions again and were successful 30 November 2015. A few days later they were transferred to the exhibit in the rainforest entry. Copulation was observed in late December 2015 but despite living together for six months they never produced offspring. It's possible she was pregnant because based on her weights she had steady weekly gains and a sudden lost one week. No infant, fetus, or blood was found on exhibit and we decided to introduce the male to the younger sister, Cai.

The introduction of Roach and Cai on 2 June 2016 went much smoother although there was some chasing and displacing for a week before they finally settled down. Copulation was observed a few times in mid-June. Cai's weight was monitored weekly since introducing the pair together and after observing copulation, staff established a due date in mid-December. Roach was transferred to the exhibit housing Blackwell, the other female loris, on 8 December 2016 in anticipation of Cai giving birth. The exhibit was due for a deep cleaning so it would be a better environment for the infant(s); however, on 17 December 2016 twins were found on exhibit and the deep cleaning project was cancelled. The excitement of new pygmy slow loris babies in nearly five years was coupled with a little concern over who was going to care for the fraternal twins. Cai and Roach were housed with 2.0 giant jumping rats (*Hypogeomys antimena*), who were transferred to the entry exhibit with Blackwell and Roach so the new mom has one less thing to worry about. This was a new exhibit for babies, a new mom, and a new staff- only one of the two staff members who cared for the last two sets of twins was still employed at Moody Gardens. The pygmy slow loris infant husbandry protocols were initiated and four new biologists were integrated into the infant care. The increase of biologists from two to five was for a variety of reasons- to cover keeper days off, to allow staff that lived close by to come in late and do night checks (and intervene if necessary), and to impart knowledge on the how's and why's of the infant protocols to allow more staff to understand and practice baby handling and weighing, gender identification, and inspection of infants for potential signs of infection. Text messaging was vital to communication amongst staff for these twins. Weights were texted each morning to all five biologists and the rainforest curator and any potential issues were also sent via descriptions or pictures. Minor issues were reported and resolved themselves within a few days. The female had a potential reaction to the food dye on her foot/ankle for a few days. The male had a small scab on inner left leg on day seven, two small circular patches of thinning fur on the shoulder blades (potentially from sister grabbing him) on day 17, and recurring eye discharge from day 11 to day 94. Since his weight gain and behavior seemed strong and normal, the eye discharge was monitored daily. By day seven, weight gain with these twins surpassed all of the previous infant weights and by day 13 they were both over 50g, see Table 1. Staff presumed this was due to a different mother and that babies were

actively nursing from all 4 nipples; for LuYen, her babies seemed to nurse mostly from one side only utilizing two: four nipples, which possibly accounted for their slower weight gain.

**Table 1: Pygmy Slow Loris Infant Weights**




**Prehensile Tail Porcupine (*Coendou prehensilis*)**

In 2004, the Rainforest at Moody Gardens opened a mammal exhibit. We acquired 1.1 prehensile tail porcupine for the nocturnal exhibit. The female, Bobby Sue, was a year old and was captive born at another facility with keepers giving her extra exposure to being handled. Upon her arrival at Moody Gardens, she was introduced and housed with an older male and there was no copulation noted between the pair for the two years they were together. A training program was implemented for the porcupines. Although both participated, Bobby Sue was more agile and eager to engage during each session. After the male passed away in 2006, a younger male, Bono, was acquired in September 2007. Bono was also included into the training program but participated at a slower pace. In less than a year they produced their first offspring- a male born 29 July 2008. Gestation for this species is six months. From 2008-2014, this pair produced 8 viable offspring. There were 2 miscarriages during this timeframe at various stages of development.

Bobby Sue cared for all her offspring without needing any assistance from staff. She was a calm, nurturing mother which complimented her demeanor as an exhibit animal. With the birth of their first offspring, biologists kept a hands-off approach to infant care only weighing the baby daily for 30 days, then every other day for two weeks, then weekly until baby was five months old, and finally monthly just like the adults. This hands-off approach continued with each of her offspring. Obtaining infant weights was two-fold: 1)to make sure the infant was

gaining weight daily since staff rarely saw mom nursing 2)to use as a comparison for future offspring. Infant birth weights ranged between 375-548g with an average of 460g. Two infants lost weight within the first five days. Baby #3 (a male) lost 15g day one which was attributed to thunderstorms overnight (mom and baby were housed outside). This was a loss of 3.57% body weight. Baby #5 (a male) lost 4g day one and 24g day two. This was a total loss of 5.77% body weight. No environmental factors could be identified to attribute to this infant's consecutive weight loss. The infant was observed nursing during this time and staff decided to let mom continue, hoping it was a baby still trying to figure out how to nurse. There were no other signs of potential issues to indicate either infant was in ill health or needed keeper intervention, i.e. runny nose, conjunctiva in eyes, lethargy, change in body position while resting, etc. It is important to note that although biologists kept a hands-off approach for infant care, we did attempt to expose each infant to being handled and touched for short periods of time, as Bobby Sue was when she was an infant. Care for the offspring varied from three to six biologists, each time incorporating new staff, as turnover occurred throughout the years. One team member served as the point person for the three-month growth monitoring who had been involved with past babies. The primary role was not involved daily husbandry, but was available to supervise newer staff handling, weighing the babies, and to answer any questions.

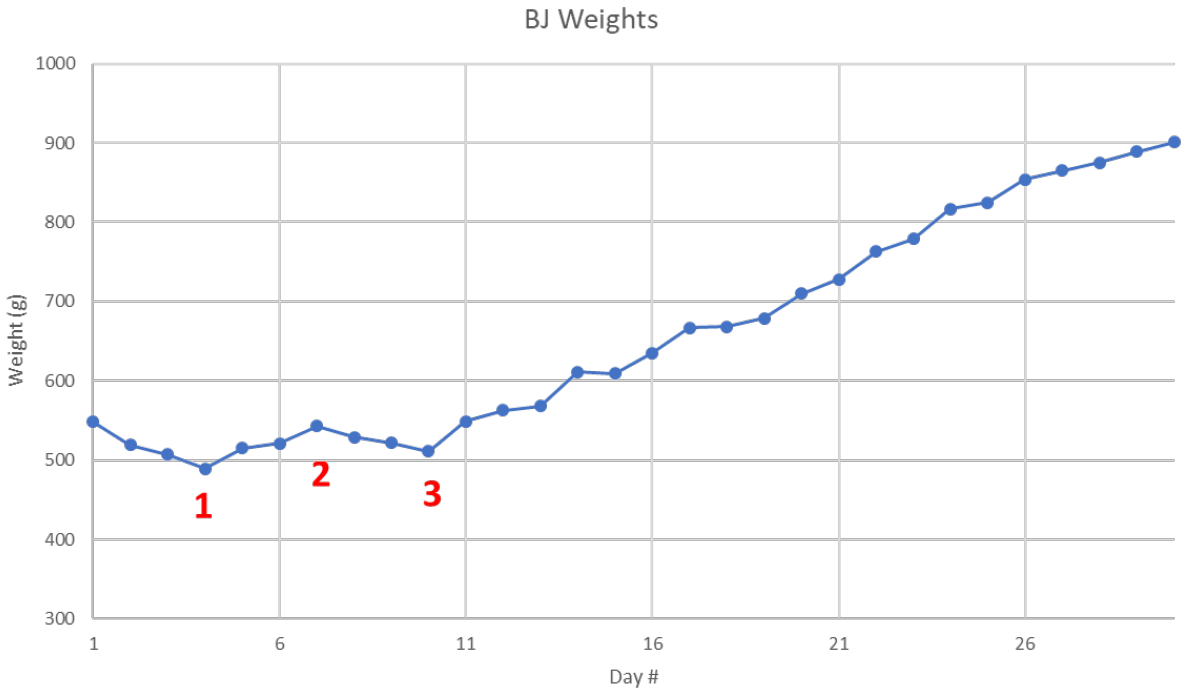
In 2015, the SSP recommended Bobby Sue be retired from breeding status and she was integrated into our animal ambassador collection in May 2016. A new female was obtained on 4 November 2015 to be paired with the current male, Bono. Cora was born 23 April 2013 and was also parent raised. No training notes were recorded for Cora from at her previous facility although she was part of their animal ambassador program. The introduction of Cora and Bono took nearly a week before the new pair seemed to tolerate each other's presence. Cora was three years old when she got pregnant and it was her first recorded pregnancy. After giving birth to a female porcupette named Bora on 26 June 2016, dam appeared confused on how to nurse. During the initial hours of observation, the mom would not stand up to facilitate nursing and appeared agitated by nursing attempts. The female did not remove placenta during the first day, so the decision was made to remove it on day two and apply tincture of iodine to the remainder of the umbilical cord and base. Cora never removed the umbilical cord and it was found on day four under an exhibit log.

Daily weights and observations, including a nursing log, were recorded to ensure the baby was successfully nursing. Since positive weight gain was recorded daily, the decision was made to continue monitoring through observations and daily weight recordings. An interesting observation was that mom repeatedly presented her rear end to Bora so she could consume her feces. Though this behavior had been observed with Bobby Sue on occasion, it occurred at a much higher frequency with Cora. Bora eventually figured out a way to nurse by lying down and pushing the dam up to standing position. This feeding strategy was different than previous dams allowed, but it was successful for them. For the first eight days Bora was weighed in the morning and late afternoon. If there was significant weight loss, staff was optimistic a decline in health could be caught early and intervention with supplemental feeds and/or antibiotics would be implemented. Weight monitoring continued for the first three months, following the guidelines that had been established with the other female's infants. Bora did have

consecutive weight loss on days one and two, losing a combined 28 grams (loss of 5.48% body weight); however, by day eight she had surpassed her birth weight and was showing a slow but steady climb in weight indicative of a healthy porcupine. During the first month, Bora was weighed by four biologists who were familiar with our porcupette handling protocol to increase likelihood of future rearing success.

Cora gave birth to a second female porcupette named BJ on 31 July 2017. BJ was weighed upon discovery and was larger than her sister by ~5%. Actually, she was our largest baby porcupine born at Moody Gardens- a whopping 548g. During several hours of observation, no nursing was recorded. She was weighed daily and after three consecutive days without nursing being observed and weight loss of 11.15% body weight, the decision was made to administer supplemental feeding. In reviewing another protocol, the staff did not feel they had enough information regarding hand rearing. There was no preferred supplemental formula, no stomach capacity to calculate amounts to offer each feed, or suggested number of feedings per day. On day four staff offered kitten milk with Pedialyte, again making use of the feeding formula that was previously successful with our pygmy slow lorises. She was fed by four to six biologists five times per day until day 24; four times per day until day 45; three times per day until day 67; two times per day until day 86 at which point milk was no longer offered. After each feed she was stimulated, given a little extra handling, and was returned to the exhibit on a low branch, which she seemed to prefer. Observations continued for any signs of attempted nursing, and while there was some curiosity and the occasional discovery of a nipple, it was not enough of a feeding response for the vet to feel comfortable in reducing the supplemental feedings. On day seven the kitten milk ran out and Esbilac formula was used that was on hand. Over the next three days her overall feeding response declined and three days of weight loss occurred, totaling a 6% body weight loss. Research into formula alternatives identified puppy milk as a potential substitute. Following a clinical visit on day 10 with a note of dehydration, staff switched to puppy milk and watered down the formula. Feeding response immediately improved with the switch to puppy milk and weight gain resumed. Table 2 shows BJ's weight progression and when hand rearing began with kitten milk (1), the switch to Esbilac formula (2), and the switch to puppy milk (3).

**Table 2: BJ Weight Graph**




*Significant Events: (1)hand rearing began with kitten milk, (2)the switch to Esbilac formula, (3)the switch to puppy milk.*

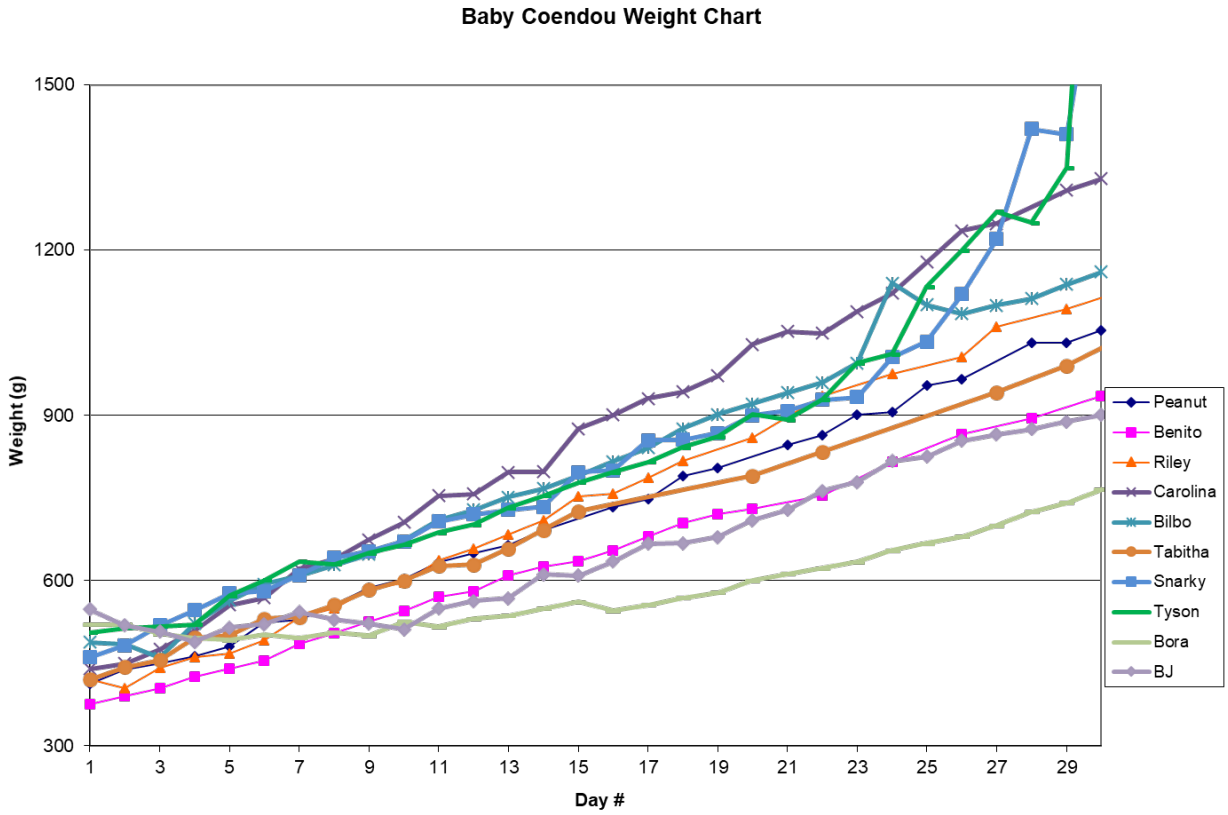
The first hurdle with hand rearing BJ was teaching her to nurse. Adjusting to the nipple took some time as she initially chewed rather than suckled. Positioning was also a challenge. Initially biologists sat on the floor in secondary containment with legs crossed and placed her in our laps- one person fed and the other focused on keeping her in a good feeding position. We progressed her to a standing position by raising her front feet and holding the syringe in one hand while supporting her body with the other hand so that this could be done with just one biologist. As she grew comfortable with our approach, she eventually could be held in our hands and remained relaxed while she ate. She even started grabbing the syringe and held onto it while suckling. On day 18, baby food was added to her diet directly into the syringe with the bottle nipple. This caused some issues because the nipple would clog and frustrate BJ. We found that adding Pedialyte to make the consistency more liquid worked quite well. On day 20, the syringe with a nipple was switched to a small bottle with a nipple due to the large volume of milk she was consuming. On day 27 she began eating small pieces of soft fruit. Ten grams of fruit per day were offered with her milk allotment. Banana and apple were the initial fruits offered but cantaloupe, pear, and cooked yam were integrated into her solid food allotment. Since she lived on exhibit with mom, she had access to solid food and was observed mimicking Cora by picking up food pieces and mouthing them. Although we offered her only 10g of food with her milk daily, once she acquired the feeding skills she was observed eating from the food trays periodically to more regularly as she got older. Food amounts we offered remained at 10g and as the number of feeds per day decreased, the total percentage of milk offered also decreased which mimicked weaning if she was being raised completely by mom.

Once BJ began to urinate and defecate unaided, biologists began to train her to use the latrine that the adults utilize. While she was still a week old she would remain still on the scale but soon became too active and large so she was placed her in a gallon bucket to weigh her. She soon discovered that she could urinate in this bucket immediately after eating and would be reinforced with tactile or some playtime. This was important in transitioning her to utilize the latrine on exhibit. If she did not urinate in the bucket while she was being weighed post feed then biologists would to place her in the exhibit latrine and wait until she urinated. It took a few minutes and sometimes a few placements back onto the edge of the latrine, but within a week, she seemed to understand the concept and started urinating in the latrine consistently and more quickly after being placed there. To learn where the latrine was and the route to get there, after she finished and received tactile reinforcement, biologists allowed her to crawl off the latrine and wander around the exhibit, eventually making her way up the perching towards mom.

Unlike our previous porcupettes, BJ remained on or near the floor of the exhibit well after most would have begun venturing into the perching. Once she showed steady weight gain, biologists began placing her on the perching in the exhibit for exercise, balance, and to start using that prehensile tail, which she had yet to utilize effectively. With frequent exercise on the perching, grip and mobility improved, she began climbing up into the perching unaided and started to utilize her prehensile tail. Even though Cora was not nursing she still came to the floor to stimulate BJ after biologists fed her and returned her to the exhibit. Cora also continued to present for BJ to consume feces. After one month there were no recorded nursing attempts by Cora.

While hand rearing BJ, biologists recorded notes and observations into ZIMS. Our recording included stimulation required, urinations, defecations, feeding quantity and response, before and after weights, enclosure temperatures, abnormal behaviors, and mood. With her latest offspring, BJ, the staff feels better prepared and experienced in hand rearing if the need arises. Based on BJ's growth curve, it was concluded that hand rearing did not have a negative effect on her development. Her weights compared to parent reared porcupettes were within normal range. Table 3 contains weights from all porcupines born at Moody Gardens. There is a separation between weight progressions from Bobby Sue's babies to Cora's babies. It is important to note that Cora's second offspring, BJ, was the heaviest porcupette born; however, lack of feeding from Cora resulted in significant initial weight loss and she remained of the lower tier of weight gain. Establishing parameters on an infant's percentage of body weight lost before biologists begin supplemental feeding, incorporating multiple biologists for knowledge and experience, and having puppy milk on hand around due dates, are now part of our infant protocols for porcupines.

**Table 3: Cumulative Baby Porcupine Weight Graph**




**Rodrigues Fruit Bat (*Pteropus rodricensis*)**

A female that joined the Rodrigues colony in 2015 gave birth to a female pup (Donna) on June 12, 2016. The dam seemed confused and parked the pup immediately after birth instead of holding it and nursing it. Several attempts were made by the mom to pick up the pup, but she was unsuccessful. Another female in our collection, who had recently given birth and was successfully caring for her own pup, was observed demonstrating handling techniques, while "Peaches" (the new mom) was close by. During two hours of observation by staff, the pup repeatedly placed its head through the exhibit meshing and several male bats were observed antagonizing females. As Peaches became increasingly agitated she began dragging the pup by its leg and biting its head. For safety reasons, the decision was made to remove the pup and begin hand rearing her.

Around the clock nurturing would be required and since our facility is not set up with a medical nursery, two keepers were tasked with hand rearing this female bat pup, Donna. When Donna was not in the rainforest being cared for, the two keepers alternated taking Donna home in a transportable brooder nightly and on weekends. Tincture of iodine was applied to the umbilical cord and base for five days and the pup was fed every two hours for the first two days. Days three through ten she was fed seven times per day, then dropped to six times per day until day 26. Feeding was administered using a bat nipple and Esbilac milk with a few drops of reverse osmosis deionized (RODI) water via syringe for additional hydration. On day five, due to

shortage of liquid Esbilac, Esbilac powder mixed with RODI water was offered; however, the consistency was never achieved for Donna to drink it successfully. She had problems swallowing, consistently spit-up, and had minimal weight gain. On day seven the diet was changed after communication with Philadelphia Zoo. Philadelphia Zoo vet staff and SSP coordinator were contacted for guidance in hand-rearing as they are successful in breeding and hand-rearing this species. This recipe included Carnation evaporated milk, Enfamil Poly-Vi-Sol liquid vitamin, and Lactase liquid enzyme. The milk ratio was 2/3 milk: 1/3 5% dextrose. To calculate a daily percentage for food intake, the formula sheet utilized with the infant pygmy slow lorises was slightly modified and initially all calculations were done by one biologist (who assisted with all the loris infants) until the second biologist felt more confident with the formulas. Water was offered daily with the milk recipe throughout the hand raising as humidity in the brooder was challenging to maintain and staff did not want dehydration to become a factor. Communication was vital to the success of both biologists and feeding Donna. What was a good speed to push the milk in the syringe? How are you maintaining humidity overnight? What do you do when she falls asleep while drinking? What's the best way to prop her upside down on the heating pad so there's less wiggling? What's the fecal output and consistency? There was a lot of information exchanged and the rainforest curator was included in the conversations so she could relay updates to Philadelphia Zoo. During each feeding a variety of data was recorded and later entered into ZIMS- temperature, humidity, defecations, urinations, food consumption, pre and post weights, and activity levels. For mobility purposes, Donna was housed in a brooder box made from a converted ice cooler. The brooder was able to plug into car outlets which assisted with temperature regulations during travel. She was given a stuffed bat to cling onto and towels were on the bottom of the brooder in case of a fall.

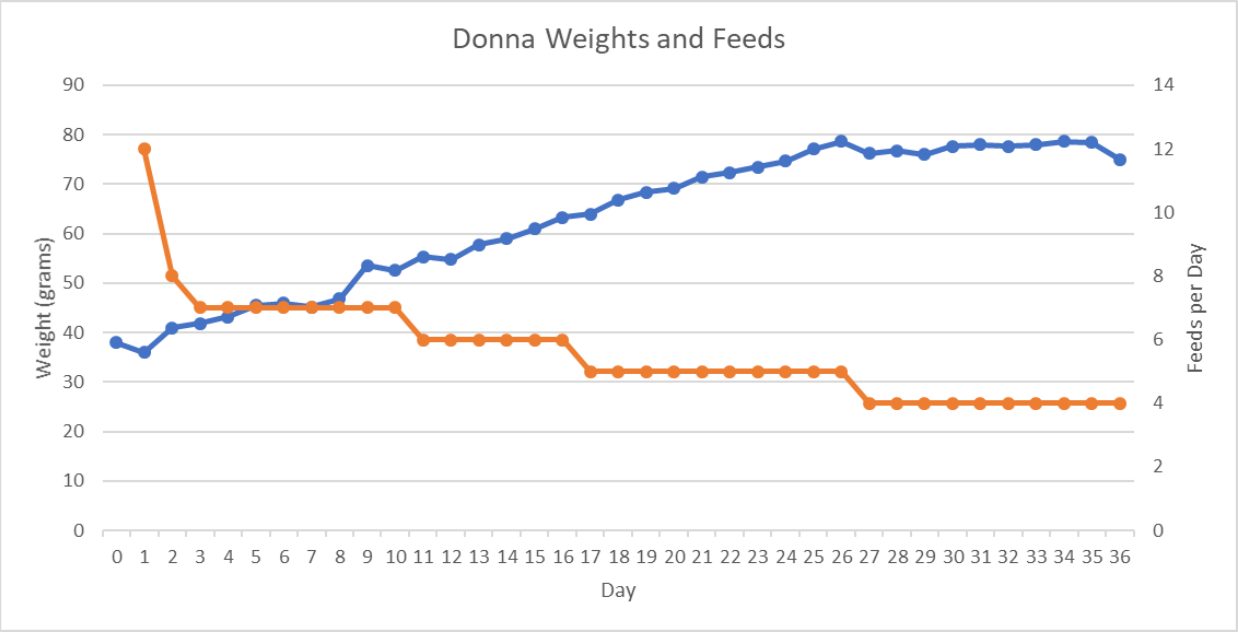
As Donna grew and gained weight, the early morning and late-night feedings were discontinued and she no longer needed to go home with the two biologists. When she began staying on property at night, two additional staff were added into the rotation for feeding so they could come in and do an evening feed. As experience with feeding increased, food intake, feeding response, urination, and defecation also increased. On day 24, she was given access to a vertical incubator to encourage movement and physical activity. This began for an hour per day and slowly increased to 4 hours per day. On day 30, she was placed in a small howdy cage for ~20 minutes twice day and put into the Rodrigues bat exhibit for short periods of time so she could start the process of slowly being integrated into the colony. There were no adverse reactions observed between her and the adult bats.

On day 24, solid food (ground Mazuri softbill diet) was incorporated into her diet based on recommendations from The Philadelphia Zoo hand rearing protocols. Our bat colony did not receive any type of biscuits in their diets and the four biologists began noticing that Donna had some issues consuming this "gruel". On day 27, her feedings were reduced to four times per day and she encountered a slight weight loss which had not occurred since day 12. With reduced milk feedings, the introduction of solid foods, and a slight weight loss staff was not initially concerned believing it was a minor side effect of weaning. Her weight was nearly identical to a hand raised Philadelphia Zoo bat at this age and we continued following the guidelines. During the next days, biologists noted that her weight had plateaued and

approximately half of her defecations were abnormal with a change in texture and consistency. On day 36, she was found deceased in the incubator. Her necropsy report stated, "The cause of death is bacterial sepsis. Bacterial emboli were seen in most of the examined organs. The source for sepsis was not evident in the submitted tissue set. Likely sources for sepsis in an animal this young include umbilical infection or cutaneous wounds."

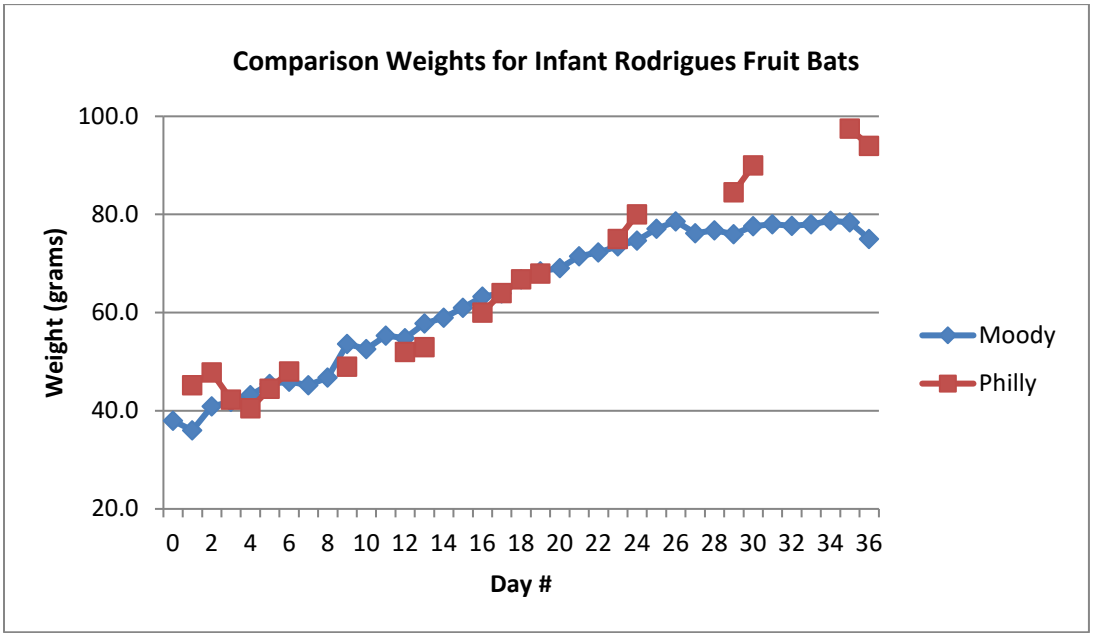
When analyzing Table 4, steady weight progression can be seen up to day 27. As her weight increased we were able to reduce the number of feedings per day and still maintain a steady weight increase. Comparison weights for Donna to the average weights of hand reared Rodrigues fruit bats at Philadelphia Zoo can be seen in Table 5. Due to the number of factors that changed in close succession (vertical incubator, solid food, quantify of feeds) it is difficult to identify any one item that may have contributed to her death. It is also possible that none of these changes contributed to her death and the infection would have killed her regardless.

**Table 4: Rodrigues Fruit Bat Weight and Feeding Graph**




*Blue line is weight in grams, orange line is number of feeds per day.*

**Table 5: Comparison Weight Graph for Infant Rodrigues Fruit Bats**




Assuming that the infection was the only cause of death our data suggests that our hand rearing efforts were successful and had infection not been present, the pup likely would have continued to thrive. For the future, the introduction of solid foods will be in the form of baby food and soft, palatable foods like banana and cooked yam instead of a biscuit or pellet since the pelleted diet was the component in question. Also, any significant changes in routine be implemented several days apart so there would be a more discernible link to changes in the pup's progression. Finally, maintaining minimal staff for care and more detailed record keeping will not only assist with communication but can help identify areas for improvement in future efforts.

**Common Vampire Bat (*Desmodus rotundus*)**

What better way to ring in a new year than with a new baby? On the morning of 1 January 2018, the mammal staff counted an extra vampire bat. Counts are done twice daily as we have a breeding population and females can give birth at any time of the year. Sadly, a few hours after noting the new addition, mom was found with a vaginal prolapse. The vet recommended applying sugar to the area for 30 minutes to reduce tissue swelling. A howdy cage was hung from the ceiling of the exhibit to accommodate the ailing mom and her new baby so they could be isolated yet still be integrated within the group. A few hours after the sugar application, the tissue re-prolapsed and she was taken to the clinic for surgery. The surgery dealt with severe inflammation and the while the tissue did not fully revert back to normal it did revert enough for a purse string stitch to hold it in place. Mom was returned to the exhibit howdy cage with baby. The vets suggested to start supplemental feedings for the baby, as mom's mammary tissue did not look enlarged and she may not be producing milk. By the end of the day mom had passed away and the staff was left a with the frantic and daunting task of finding what milk supplement is best to use for a vampire bat. However, finding an appropriate milk supplement

is not enough. What is the stomach capacity of a vampire bat so we know how much to feed it? How many feeds during the day and night does a vampire bat need to receive proper nutrition? What is a normal percentage weight gain for a baby vampire bat? These are common questions for any baby animal that needs supplemental feedings to survive. Very little information was available on short notice.

The next day the formula sheet was printed and adapted for a vampire bat. This formula sheet was specific to the pygmy slow loris stomach capacity (50ml/kg) but was used while we attempted to contact other facilities with vampire bats to find out if they've ever had to hand raise an infant. There were several types of milk supplements on hand, and chose to use powdered goat milk mixed with reverse osmosis deionized water (RODI). Goat's milk is naturally lactose free, which should minimize any potential digestion issues for the baby bat. Six feeds were done- 0800, 1100, 1400, 1630, 1930, and 2230. A weight of 5g was obtained before the first feed began. Tincture of iodine was placed on her umbilical base as a preventative to infection as the cord was already gone. She was held in a towel vertically as drops of milk were placed on her lips from a 1cc syringe to encourage her to lick the milk and swallow on her own. However, we soon began using a Q-tip to massage her throat to encourage her to open her mouth and swallow. After nearly 20 minutes she mostly stopped responding and we halted offering milk. It was difficult to determine if she actually drank as some milk went out the side of her mouth waiting for her to lick her lips and while swallowing. Afterwards she was placed in a towel on an incline in the howdy cage on exhibit. A petri dish with blood was also in the howdy to encourage female bats to check in on the baby and drink blood. At the 1400 feed, based on recommendations from an older bat husbandry manual, milk was changed to Similac. The biologist for the next feeding found her face down in the petri dish of blood. With the minimal observations of the exhibit no bats were seen in the howdy with the baby so the petri dish was removed. The baby bat was cleaned up and while offering milk she regurgitated quite a bit of blood. There was no sign of aspiration. She actively drank and had a good feeding response but it took a while to get all the blood up between drinking milk. She drank ~.20ml milk and kept it all down. At the next feed, another good feeding response but still some bloody spit up. At the 7:30pm feed she was hanging on the side of the mesh, not in the towel on the bottom. She did not eat well and appeared sleepy. For the last feed, she also did not eat well but there was no bloody spit up during her feed. She also appeared sleepy. A total of 2.9ml milk was offered; she drank 1.3ml milk.

The next morning, 3 January 2018 she was found deceased in the howdy cage. Her weight was 6g. Three biologists assisted in feeding this baby and monitoring the colony. What could have been done differently to ensure success? Start feeding immediately after mom returned from the vet with instructions from the vet to start supplemental feeds? Offering a consistent supplement instead of switching halfway through day one? Would capturing female bats and placing them in the howdy cage have been productive or stressful? Would removing the infant and placing it an incubator for warmth and isolation been better? Staff is still gathering and reviewing information to establish infant vampire bat protocols for the future.

**Conclusion**

Regardless of taxa, the mammals in the Rainforest at Moody Gardens that produce offspring are monitored by staff to ensure optimal health. Minimally intrusive monitoring of an infant's weight can be vital, if parent(s) and infant(s) safely allow it. Understanding the parameters of a species' weight gain is insightful and important. Monitoring how well an infant gains weight allows us to understand how mom is nursing, producing milk, and caring for herself. Utilizing weight data also allows for future comparisons of offspring weights so each infant can be tracked on how well it is following the normal growth curve for its species. Training new staff on how and why weights falls within a normal gain and range may seem initially overwhelming but it is important knowledge to convey so more biologists are familiar with the intricacies and can assist in the future. For the pygmy slow loris infants at Moody Gardens, a weight gain of 2-5g was normal; plateaus in weight or gains less than two grams elicited a cause for concern. For the prehensile tail porcupine, weight gains ranged from ~10-30g. Establishing parameters for weight loss needs to be discussed and established in facility protocols for when to intervene with supplemental feedings or vet care. This information should be in as many husbandry manuals as possible so it is less difficult for caretakers to find this information under time constraints.

The importance of sharing hand rearing, from weight monitoring to supplemental feeding to full time care, with your staff can be vital for the years ahead. Restricting infant access to a few biologists initially makes sense for communication and less stress, but biologists typically do not stay at a single facility or within a department their entire careers. If information is not shared (via dialogue or protocols) then vital information is lost and future infants suffer. Networking with other facilities that house taxa that are breeding at your facility are an excellent resource. However, protocols can be modified, if necessary, and often times what works for one individual may not work for another. Having knowledge, resources, and experience will only guide your staff on how to enhance the prenatal and postpartum care for the animals we compassionately care for.

There is a common hand rearing theme that has been learned over time, infants need to be warm, observations of parents and offspring are essential to make decisions, weigh monitoring is fairly easy but extremely important, and communication amongst staff. As we continue to breed a variety of taxa, we continue to learn and train more staff thereby ensuring the success of our breeding programs and species survival.

# Feline Fast, Feasts, and Fitness: a Model for Improving Welfare at the Big Bear Alpine Zoo

Bob Cisneros, Curator
Dariush Larizadeh, Animal Keeper
Shane Smith, Animal Keeper

Big Bear Alpine Zoo
Big Bear Lake California

At 7,000 feet altitude, Big Bear Alpine Zoo exists on a sky-island, isolated from its sea level communities. In 2015, a change in management at the zoo created an opportunity to generate a paradigm shift in animal care, focusing on evidence-based animal care management and the "Five Opportunities to Thrive" as the guides for husbandry changes and maintenance. Among the animals affected by these changes, the zoo's 0.2 mountain lions (Puma concolor) became the poster child for positive welfare, laying the framework for the rest of the zoo to follow. Considered morbidly obese prior to 2015, the mountain lions were transformed to lean and healthy states through diet changes, routine weighing, exhibit modifications, and the addition of daily behavior-based enrichment. As a result the mountain lions were transformed from inactive, lethargic, and obese cats who slept most of the day, to vibrant, active felines who as ambassadors, resembled and behaved like their counterparts in the wild, furthering our mission of connecting guests to wildlife. With a husbandry routine firmly in place, zoo staff modified the mountain lion diet further, adding a monthly fast-feast-fast diet, including oversized carcass feeding. The monthly addition of a fast day followed by a day of gorging and then followed by an additional fast day, increased natural behavior activity levels without creating any opportunities for conspecific aggression.

The genesis of the Big Bear Alpine Zoo (formerly Moonridge Animal Park) began in 1959 after a devastating wildfire roared through the San Bernardino National Forest. Two bobcats and a black bear cub were kept in makeshift cages, cared for by staff at the local ski resort.

In 1960, Big Bear Valley Parks and Recreation officially took over managing the site as more and more injured, sick, and orphaned animals began to arrive. By 1961, the facility changed its name to Moonridge Zoo. Alpine animals were sought through the Department of Fish and Game and other local agencies to make the collection interesting. In the early years, the facility was used as a holding area and then a retirement home for several Hollywood movie animal stars. "Tiger Tom," the star of Disney's Charlie the Lonesome Cougar, spent his last years with us.

In the 1980's the zoo transformed into an established facility, hiring a manager and charging admission to help care for the animals in the facility. Prior to that, with no revenue to support the facility, the care takers relied on an onsite donations box, the local grocery stores and generous donations made by supporters of the zoo and visitors to the zoo to feed the animals. While somewhat organized, its location isolated it from many of the reforms that the industry was experiencing in the 80s and 90s. As an animal park, it remained a menagerie with no conservation message, emphasis on animal welfare, and no focus on connecting zoo guests to wildlife. While the zoo boasted decades of passion for wildlife, it lacked industry best practices, focusing on its role as a rescue facility and emphasizing its collection as ambassadors of their own individual fate; animals too compromised to be released back into the wild.

However, today's best zoos rely on more than just passion in providing excellence in animal welfare and husbandry and connecting guests to wildlife. For Big Bear Alpine Zoo, making the transition towards utilizing best practices in welfare and husbandry began with the Five Freedoms (Farm Animal Welfare Council, 2012):

1. **Freedom from hunger or thirst by ready access to fresh water and a diet to maintain full health and vigor**
2. **Freedom from discomfort by providing an appropriate environment including shelter and a comfortable resting area**
3. **Freedom from pain, injury or disease by prevention or rapid diagnosis and treatment**
4. **Freedom to express (most) normal behavior by providing sufficient space, proper facilities and company of the animal's own kind**
5. **Freedom from fear and distress by ensuring conditions and treatment which avoid mental suffering**

The "Five Freedoms" are widely used in the zoo industry today. The concept of Five Freedoms originated with the Report of the Technical Committee to Enquire into the Welfare of Animals kept under Intensive Livestock Husbandry Systems (F W Rogers Brambell, 1965). This stated that farm animals should have freedom "to stand up, lie down, turn around, groom themselves and stretch their limbs," a list that is still sometimes referred to as Brambell's Five Freedoms.

For the first time in its history, Big Bear Alpine Zoo utilized the "Five Freedoms" as a baseline for assessing and promoting animal welfare as an official part of its husbandry program. Exhibits were evaluated and modified based on the first and fourth freedom, transforming bare exhibits with minimal "furniture" into natural looking exhibits with climbing structures and multiple areas for shade and shelter. Even the placement of multiple substrates added to the daily enrichment of animals in their enclosures. Additionally, scales were purchased and animals were placed on monthly routine weight schedules as a means of providing measureable results of best practices.

**Obesity as a prevalent issue**

Because the use of scales and weight management were a nonexistent part of zoo animal care management, many of the zoo's animals were obese. One of the resident male black bears, tipped the scales at 670 pounds (figure 1.) with a visual body condition score of 9+ out of 9. Today, he weighs in at 470 pounds. As a result of evidence-based management, our red tegu, housed in our Education Center, went from 17 ½ pounds to 9 pounds during a two year reduction in diet. Raccoons, some as heavy as 25 pounds and kept in a small 8 ft. by 10 ft. cage, were moved to a new exhibit with more space and climbing structures (figures 2 and 3.) and placed on diets.

Figure 1. The first recorded weight for black bear "Zuni" in 10 years was 670 pounds.

**Figures 2 and 3. Old raccoon exhibit (on left) and new "Raccoon Saloon" (on right) with perching and climbing structures throughout.**

**Mountain lions**

When Big Bear Alpine Zoo first received 0.2 mountain lions, they arrived as cubs, orphaned after their mother had been shot and killed by a rancher. The cubs were hand-raised at the home of the previous curatorial staff and presented to the public at every opportunity. They were leash trained and according to local resources, even walked outside of zoo grounds as a form of advertisement. As the cubs grew into adults, keeper staff maintained free contact, servicing the exhibit while the mountain lions were present. During the new management change in spring of 2015, it was noted that mountain lions were morbidly obese. Estimates by our current Vet of Record (Loudis 2016), who had visited the zoo several times during the past administration, placed the mountain lions at over 200 pounds each. The mountain lions were slothful, frequently sleeping while the keepers entered the exhibit to clean. It was also rare for the public to see the mountain lions engaged in any activity during zoo hours. It is uncertain whether the mountain lions' poor body condition, lack of climbing structures, or exhibit variety was responsible for their inactivity.

**Figures 4 and 5. Mountain lions "Cascade" (left front) and "Canyon" (left rear and right photo). Estimated weights for each were approximately 200+ pounds.**

**Prescription for weight loss**

While it would be obvious to state that reducing the diets for the mountain lions would result in weight loss, doing so without supportive evidence via weekly weights would be just as careless as overfeeding. Our recordkeeping was already going through the transition from minimal, anecdotal, and subjective to historical, archival, and objective observation, and from paper to electronic. A secondary system of tracking significant events (figure 6.) made it possible to log and track all significant events. Based on weight loss or gain, diets were reduced or increased by 10% and the mountain lions were monitored weekly for weight loss.

**STRING 3 SIGNIFICANT EVENTS 2018**

Use this area to record ANY event which may be considered significant. This would include but not be limited to the following:
breeding, births, deaths, amputation, weights, and moves

| DATE | INITIAL | EVENT | COMMENT |
|---|---|---|---|
| 1/3/2018 | RSS | LBS | 0.1 M02004 - Mountain Lion - Cascade = 104lbs |
| 1/3/2018 | RSS | LBS | 0.1 M02003 - Mountain Lion - "Canyon" = 102lbs |
| 1/3/2018 | RSS | LBS | 1.0 M10005 - Coyote - "Bonzai" = 48lbs |
| 1/4/2018 | DL | Move | 0.1 M17002 - Raccoon - "Karen" went to VCA for surgery. |
| 1/4/2018 | DL | Surgery | 0.1 M17002 - Raccoon - "Karen" surgery for her injured left rear foot/l |
| 1/4/2018 | DL | Move | 0.1 M17002 - Raccoon - "Karen" returned from VCA after surgery. |
| 1/5/2018 | DL | String adj. | 0.1 M17002 - Raccoon - "Karen" is on String 2 while recuperating fron |
| 1/5/2018 | DL | LBS | 0.1 M11003 - Raccoon - "Tosh" - 7.2 Kg |
| 1/5/2018 | DL | Diet change | 0.2 Mtn. Lions increased diet by 10%; 3lbs/meat per day; up from 2.75 |

**Figure 6. Significant events tracking system in addition to the standard keeper daily report and diary.**

By January 2017, the mountain lions averaged 110 pounds and a vertical view of the big cats clearly demonstrated their improved body condition score (figure 7).

**Figure 7. "Canyon" as seen from a ventral perspective.**

We used target weight ranges from other institutions as reference points for new weight ranges for our zoo mountain lions. The ability to visually inspect our cats at close range, enabled zoo staff to compare our mountain lions' body condition with AZA Felid Taxon Advisory Group's Feline Body Condition Guidelines (Figure 8.)

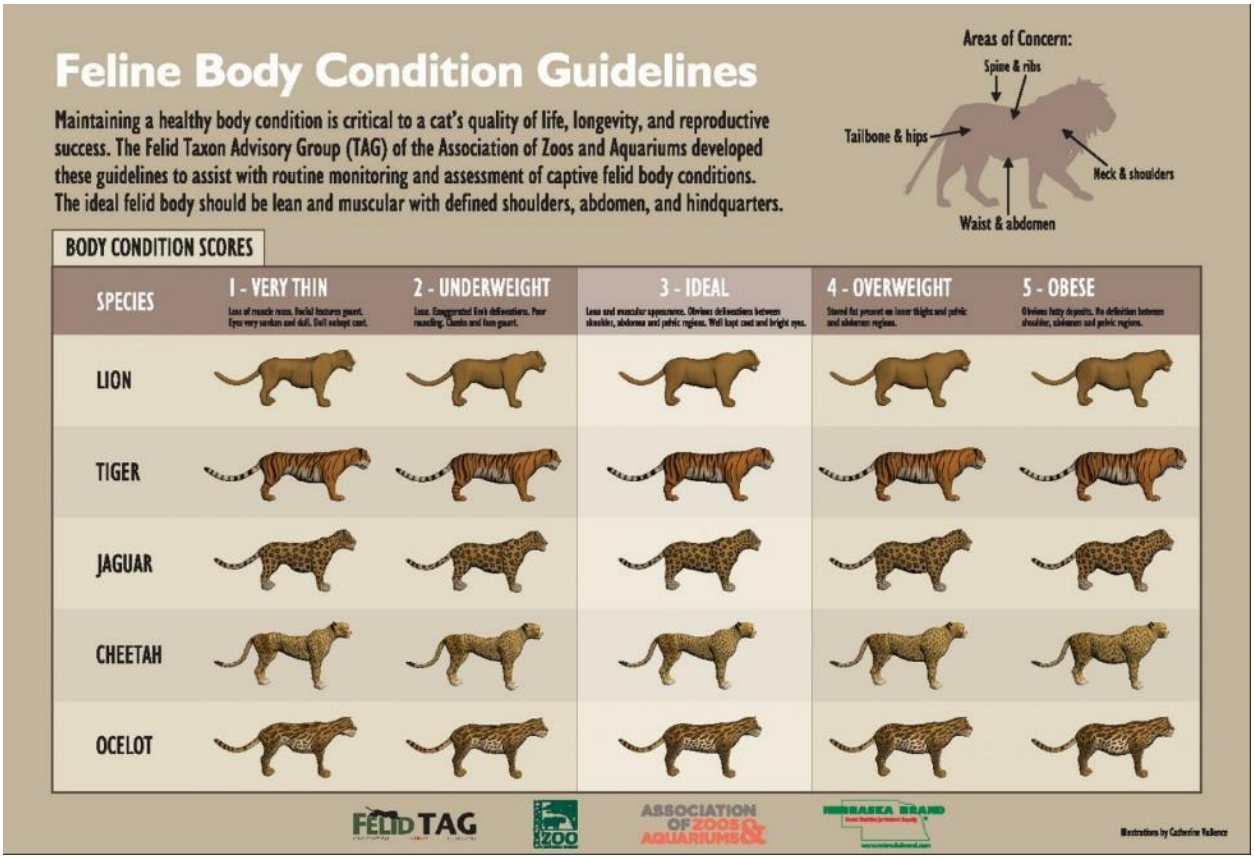



**Figure 8. Feline Body Condition poster courtesy of Nebraska Brand Diets.**

In addition to dietary changes for the mountain lions, a complete overhaul of their exhibit took place in the summer of 2015. The exhibit modification was based on providing a more enriching environment and incorporated our enrichment philosophy which was introduced when the "Five Freedoms" were introduced. The enrichment philosophy at Big Bear Alpine Zoo states that the natural behaviors of our animals will direct our behavioral enrichment and will assist our keepers in the determination of enrichment activities based solely on the behaviors they wish to elicit. Modifying a stark exhibit for mountain lions began with identifying key components that were missing from their exhibit.

Changes to the exhibit allowed keepers to promote more natural behaviors, encouraging the big cats to climb, balance, leap and land. The increased activity and muscle stimulation, combined with dietary changes and evidence-based management, promoted a more active lifestyle for the mountain lions. Keeper noted a large repertoire of behaviors besides the two prevalent "eat" and "sleep" behaviors previously noted. Figure 9 is a view of the exhibit prior to 2015. The minimalist perspective even included lowering the pond levels in order to facilitate a faster dump and fill. With climbing structures in place and more appropriate places for these apex predators to be hidden in plain sight, the cats' activity levels were a huge crowd pleaser as well (figures 10 and 11.). Fulfilling our mission of connecting people to wildlife is enhanced when zoo guests are able to experience the awe and splendor an animal engaged in natural behaviors.

**Figure 9. An igloo, a dog house, and a spool were the basic elements of the old mountain lion exhibit.**

**Figures 10 and 11. Firehose bunk hidden behind bark logs and browse allowed the cats to hidden in plain sight. Crowds were wowed by the cougar's ability to leap from ground to roof in a single bound. With the "Five Freedoms" firmly rooted in the zoo's management of its animals, the zoo was ready for the next step. While minimum standards for welfare were regularly met, it was time to go beyond**

**compliance** and focus on what more we could do in order to make our animals thrive. Borrowing heavily from our world famous neighbor down south, the zoo began to promote the "Five Opportunities to Thrive" as our new commitment to animal welfare.

**1. Opportunity for a well-balanced diet.** Fresh water and a suitable, species specific diet will be provided in a way that ensures full health and vigor, both behaviorally and physically.
**2. Opportunity to self-maintain.** An appropriate environment including shelter and species specific substrates that encourage opportunities to self-maintain**.**
**3. Opportunity for optimal health.** Rapid diagnosis and treatment of injury or disease while providing supportive environments that increase the likelihood of healthy individuals.
**4. Opportunity to express species-specific behavior.** Quality spaces and appropriate social groupings will be provided that encourage species specific behaviors at natural frequencies and of appropriate diversity while meeting social and developmental needs**.**
**5. Opportunities for choice and control.** Providing conditions in which animals can exercise control and make choices to avoid suffering and distress, and make behavior meaningful.

**Mountain Lions, Species-Specific Behavior, and a new Paradigm**
Often daily, or with one fast day per week, many carnivore taxa in captivity conventionally are fed a non-varying diet of processed meat at regular, fixed, and frequent intervals (Meyer-Holzapfel, 1968). In anticipation of feeding, our cats often paced just before the arrival of keepers, a stereotypic behavior often experienced in other zoos. With the weights of the mountain lions under control, their activity levels at all new peaks, it was determined that their diets could be tweaked even further to further enrich their lives and possibly help improve the diet and enrichment strategies for the rest of our felids at the zoo (snow leopards and bobcats).

If gorging is a behavior that large felids often experience in the wild, could a paradigm be established that would encourage this behavior but also promote more natural behaviors? A dialogue was established with past zoo nutritionist Mark Edwards, Associate Professor of Comparative Nutrition at California Polytechnic State University, San Luis Obispo about possible health advantages of a gorge-based diet for our two mountain lions (Edwards, 2016). The project received the approval of Dr. Edwards and a paradigm was established that would involve a 3.75 kg carcass and two or more fast days. During discussions with Dr. Edwards, it was noted that the one caveat for this paradigm was an increase in conspecific aggression. During the summer months, interns were used to sample baseline behaviors prior to starting the gorge-based diet. Interns were tasked with collecting behavioral data before and after feedings during random days. Table 1 lists the behavioral inventory used for the behavioral baselines while figure 12 depicts the ethogram template used. Both ethogram and template were used during baseline and actual studies.

Once baseline information was collected, large rabbits were ordered with the specification that they be no greater than 4.0 kg and no smaller than 3.5 kg. Fast days would be adjusted in order to ensure that weekly totals would equal 7.5 kg of meat if a rabbit was over or under weight. As the new feeding schedule was implemented, summer interns were again tasked with collecting behavioral data. Should any conspecific aggression take place, baseline data would help to justify continuing the project or stopping it altogether. Although we are still in the early stages of the fast-gorge-fast diet paradigm, our conclusions on the efficiency of this program and its cross over to other felid species will not be determined until early fall. While we noticed little to no aggressive behavior, we did encounter a few other behaviors that were not anticipated.

**Table 1. Cougar Ethogram Behavior Description**

Resting (R ) Cougar is resting on side or belly, but not actively responding to stimuli; make note of asleep or awake and where

Pacing (PA) Cougar is walking perimeter of exhibit at a constant speed and repetitively

Grooming (G) Cougar is grooming/licking fur and/or paws

Vocalization (V) Cougar is making noises to communicate with others; includes: hissing, growling, purring, chuffing, squeaking, screeching

Climbing (CL) Cougar is climbing trees and/or rocks in exhibit; locomotion without touching ground

Walking (WA) Cougar is walking around exhibit, on ground

Chasing (CH) Cougar is chasing another cougar around exhibit

Scratching (S) Cougar is scratching self

Touching Objects (TO) Cougar is scratching and/or touching objects

Watching (WT) Cougar is actively watching another cougar or object; note position of ears (back vs. forward), whether tail is twitching, and where in exhibit

Attacking/Agonistic (AA) Cougar is pouncing, stalking, pawing, crouching, or aggressively interacting with another cougar or person

Playing (P) Cougar is non-aggressively playing with, chasing, pouncing on other cougar or object

Stretching (ST) Cougar is stretching limbs and/ or body

Out of Sight (OOS) Cougar is out of sight of observer

Other (OTH) Cougar is displaying behaviors other than ones listed

Interaction with Keeper (IK) Cougar has immediate change in behavior in presence of Zookeeper; note for how long and which individual

**BIG BEAR ALPINE ZOO**

Ethogram Template

Research your chosen species and fill out the headings in the form below. Use a stopwatch and tick the behaviours observed at 30s intervals.

| Name(s) of observers | Date | Study Species |
|---|---|---|
| Weather | Time | Study Animal (identifying features) |
| Other relevant information (e.g. no. of visitors, feeding time, keeper presence) | | |

| Time (mins) | Behaviors (Fill in the headings below with appropriate behaviors for your focal species e.g. sleep, eat, play, groom) | | | | | | | | Notes (Record anything affecting behavior) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Other (describe) | |
| 1:00 | | | | | | | | | |
| 2:00 | | | | | | | | | |
| 3:00 | | | | | | | | | |
| 4:00 | | | | | | | | | |
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| 17:00 | | | | | | | | | |
| 18:00 | | | | | | | | | |
| 19:00 | | | | | | | | | |
| 20:00 | | | | | | | | | |
| Totals | | | | | | | | | |

**figure 12 the ethogram template.**

**Table 2. Compared diet: fast-gorge-gorge diet and regular diet**

| Day | SUN | MON | TUES | WEDS | THURS | FRI | SAT | TOTAL |
|---|---|---|---|---|---|---|---|---|
| GORGE FAST DIET | 1.25 kg. meat | 1.25 kg. meat | 1.25 kg. meat | FAST | Rabbit 3.75 g | FAST | 100-200 gr | 7.5 kg meat |
| REGULAR DIET | 1.25 kg. meat | 1.25 kg. meat | 1.25 kg. meat | Fast | 1.25 kg. meat | 1.25 kg. meat | 1.25 kg. meat | 7.5 kg meat |

**Fast-gorge-fast diet produces surprises in behavior**

While most anticipated some aggression and possible increase in stereotypic pacing, there were a few behaviors that were more prevalent than others. Because the project is still ongoing, these bevaiors will simply be noted with greater explanation at the completion of the study.

**Table 3. Noted behaviors during Fast-Gorge-Fast diet**

| | |
|---|---|
| Consumption of large rabbit | Mountain lions took 2+ days to fully consume large rabbits, sometimes caching the remains for later consumption. |
| Fecal Output | Notably larger following gorge day with decreasing size after the following fast and partial fast day. |
| Activity levels | Highly active during the days just before gorge day but activity was reduced completely on gorge day and the two days following. By the next regular feed day, activity levels returned to normal. |
| Shifting | Shifting is required in order for the keepers to clean and feed. On Friday and Saturdays, it was virtually impossible to get the cats to shift, much less engage in any other behavior. |
| Other notable behavior | While the two mountain lions regularly defecate and slightly cover their fecal, it was noted that the cats spent more time burying their fecal than ever before. It is possible that this a natural behavior encouraged by the need to prevent its scent from broadcasting its presence. |

Because of the decreased activity level of the mountain lions following gorge day and the keeper's inability to shift the animals because of the cats' lethargic behavior, this project may be continued but modified to a once a month occurrence. One thing is evident, reduced weight overall, increased activity levels and promoted the expression of natural behaviors not just in our cats but in all animals where obesity was addressed.

**Figures 13 and 14. A comparison of mountain lion "Canyon"**

**Figure 15. It's difficult to be concerned about the fate of an animal that you have never seen.**

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# Bear Necessities

## "The modifications required to successfully complete a necessary behavior with two species of bear"

By Kelly Nields and Jessi Culbertson

## Introduction

The Northwoods section at the North Carolina zoo has 2.0 Grizzly Bears, Tommo and Yepani, and 0.3 American Black Bears (1.3 at the start of training), Yanu, Holly, Luna and Nova. As of two years ago, physicals were done yearly but the importance of routine bloodwork became more evident with 4 geriatric bears.

Voluntary blood draw is not a new concept in the zoo field, but many facilities are reluctant to get on board with the behavior. While front line staff are enthusiastic to take on this multi-layered behavior, they usually hit a wall from the needs of safety, time management and general support from upper management. This can create road blocks that are difficult to navigate and cause keepers to lose their enthusiasm. This paper will highlight how we navigated these road blocks and the modifications that had to occur to accomplish the goal while satisfying everyone's requirements.

We found that it was important to highlight how our field is evolving to find better ways to address the needs and concerns for the animals in our care. Voluntary blood draw meets this mission and we needed to find the best way to accomplish the complex behavior. In 2016, the Northwoods team got voluntary blood from our bears with the collaboration of our Zoo training consultant and supportive upper management staff.

## Materials

After a trip to the Minnesota Zoo in November 2015, we got pictures of their blood portal set up. We knew going into the planning process that we would need to modify the set up to work for us and both species of bears in our care. We had a large goal setting and training meeting with the key players in the planning and implementing process:

- Kelly Nields, Jessi Culbertson, Curtis Malott, and Kelly Murphy, Northwoods Team
- Phung Lu, training consultant
- Dr. Minter, Chief Veterinary
- Guy Lichty, Curator of Mammals
- Chris Lasher, Animal Management Supervisor

During this critical meeting we were able to determine the needs, concerns and limitations that would need addressing for this behavior to be a success. Our Veterinarian stressed that he would prefer to get blood from the top vein from the front paws. He was eager to acquire voluntary bloodwork so that we could limit the need for anesthesia assisted physicals. The training consultant provided useful tips to accomplish this behavior with the set requirements needed from

the vet staff. Safety was an important factor that needed considering. It was clear that our supervisor had his reservations on the design but was quick to provide his input to resolve his concerns. He wanted to ensure that staff were protected and that the bears were not potentially vulnerable to injury as well. The safety requirements were the set up needed to be secured when not in use and extra precautions put in place to stop the bears from reaching out of the blood portal. Our curator was able to provide insight into the zoo departments that we could enlist to construct a blood portal that worked best for our needs. All of these requirements and factors came together so that we could make a clear request to our maintenance department. From this point on, it was out of our hands and just needed approval once the design was constructed. Within days, our maintenance department designed and constructed the blood portals. Upper management reviewed the construction and approved the voluntary blood draw behavior. Installation occurred quickly which allowed the keepers to immediately get started on training the behavior.

METHODS

The Minnesota Zoo positioned their blood portal low on the holding door, but our team thought we should place our blood portal higher. We went into training knowing that our bears like to sit when they are at the holding doors, so we had the blood portal mounted and welded at a height that was ideal for our bears to sit and place their front paw into the blood portal. The overall design of the blood portal was the same for both species. The initial modification for the blood portal from the original example was adding two vertical bars rather than just one.

The general training for this behavior was fairly consistent among each of the trainers. This was a completely new behavior for the section and one of the first times that we had something constructed to aid in training. We found most of the uncertainty was on the trainer side, since this was new for each of us to train, we thought our bears would take longer to move forward with this behavior. Each bear had their own way of approach but they all moved

quickly through the general steps. Our team noticed quickly that there were unexpected things happening that caused the behavior to slow or increase in difficulty. The solution was modification of the blood portal.

Modifications had to occur for each species so that the blood portal was comfortable for the bears while vet staff found a vein. Another added benefit of adjustment is it would provide an easier opportunity for the vet staff to acquire blood accurately and quickly. Yepani has very long claws and it was difficult for him to place his paw within the portal and still present enough of his paw for vet staff to locate a vein. Tommo would place his shorter claws over the front plate of the portal, but it would cause the bones in his paw to flex. Yanu had long arms and wide front paws so it was difficult for the tech to locate an ideal location for blood. The tech let us know that she needed to get blood higher up on his arm. These issues were addressed with our maintenance department and they removed the front plate. All the male bears were now able to fully extend their paws into the blood portal and latch their claws onto the outside edge of the portal.

We thought we were clear of modifications until we noticed that our black bears would extend arms out of the top of the blood portal. Not exactly what you want when trying to get blood safely…we want their blood, not ours. The black bear portal needed to have horizontal bars placed over the vertical bars to block their ability to extend their arms out of the portal. We continued training and we were at the point of fine tuning the behavior and getting the paws in ideal placement for the benefit of the vet techs. It was noticed that black bear paws are smaller and shallower than the grizzly bear paws. Maintenance helped with this problem by leveling the top of the blood portal making it parallel to the bottom of the portal. This allowed the techs to get closer to the paws without special needles to get the correct angle. Our grizzly bears did not need any technical modifications done to their blood portal after the front plate removal, but it was evident that Yepani's paw was smaller than Tommo's paw. The remedy for this problem was a simple wood block that would be placed into the portal to line up Yepani's paw. This method was used at black bear for Holly. After these modifications, we finally had a product that worked well for each species.

Black bear Blood portal

Grizzly Bear Blood Portal

CONCLUSION

Years went by where voluntary blood draw from our bears was merely wishful thinking. There were many factors to consider and an uphill battle that was exhausting to climb. Everything came together for the Northwoods team in 2016. We had a new team and a training consultant who was ready to help the Zoo accomplish some major and important goals. We worked closely with various departments to help see this behavior through to the end. Now, we are fortunate that we do not have to anesthetize our bears yearly and instead we acquire blood and can do visual exams.

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Safari Night Keeper
Disney's Animal Kingdom
AAZK Paper Presentation 2018

# Extending Animal Care into the Night

Since Disney's Animal Kingdom® opened in 1998, there has been a unique team of third shift animal keepers who work through the night to maintain a high level of animal welfare and to provide 24 hour continuous animal care excellence. The Night Animal Care Team started out as just a handful of keepers and a little over 20 years later, is now made up of 17 full time keepers. Throughout the evolution of the Night Team, Night Keepers have partnered with day team keepers and focused their efforts with these teams across the park. Today, the night team is split into two groups, Park Night Keepers and Safari Night Keepers with every animal keeper focusing with one or more of the day teams. When it was announced in 2014 that Disney's Animal Kingdom® would be expanding the park as well as extending the park operating hours, the Night Team was there to assist with providing a seamless transition into evening operating hours.

One of the new experiences included extending the Kilimanjaro Safari attraction hours from closing just before or around sunset to later in the evening. For this to occur, a lot of preparation was needed before the launch in May of 2016. More animals were added to the Savannah team's collection to be seen by Park guests, therefore it was necessary to build two new barns for more efficient housing of these animals. Lights that simulate an extended sunset were also added throughout the savannah exhibit to provide guests with an easier way to view the animals. More lights were added to the animal keeper work areas as well as the exhibits to provide animal keepers with a safe environment to work in at night. In an effort to keep the ride at an appropriate ride time length with safari trucks driving slower for safety at night, a new road was created to bypass across the main savannah. Once the construction was complete, Kilimanjaro Safari attraction had to modify their safari trucks to safely operate at night. Extra lights were installed on the front of the safari trucks to allow for better visibility for both the driver as well as the guests. They also installed red lights on the inside of the safari trucks so the drivers can see the guests for safety reasons. The construction of the two new barns, instillation

of the light poles, addition of a new road, as well as driver practice with the newly equipped ride vehicles all had to happen while the park was closed to guests with animals in the savannah exhibits.

Although maintenance work has happened in the savannah exhibits with animals out before, this expansion was the most amount of work to happen at one time. As construction took place in the savannah exhibits to prepare for the extended night hours, night keepers had to be present to monitor the crews and the animal. This was to ensure that there were no negative interactions between the crews and animals and to maintain the highest standards of animal welfare throughout the work. The work required night keepers to escort construction crews and equipment into the savannah exhibits as well as maintain a visual on the animals in the area. This night keeper watched for signs of stress or other behaviors that would indicate that the animals were affected by the construction that was happening in the savannah exhibit. If the keepers felt that the work was detrimental to the animals, they had the ability to stop the work. If work was stopped, it would not continue until a solution to the issue was found and the highest level of animal welfare could be maintained. Once a majority of the construction was done, the attractions team had to practice running the newly updated Kilimanjaro Safari attraction ride vehicles in the dark, to allow the animals to adapt to the vehicles and for the drivers to be comfortable driving in the dark. Today, with the Kilimanjaro Safari attraction running as late as 11pm, there is significantly less time between the park closing and reopening to get work such as landscaping, ride path repair, underwater exhibit cleaning, irrigation work, and electrician work done. In an effort to continue to maintain a safe and efficient work environment for both people and animals in the savannah exhibits at night and to continue to maintain a high standard of animal welfare, Night Keepers continue to strengthen and build partnerships with maintenance teams.

Day savannah teams and the safari night keepers had to work closely together to prepare the animals for extended hours. Many animals had their shifting schedules changed to bring them into their barns earlier, later, or even were adapted them staying out in savannah exhibit overnight. Most of the species in these mixed species exhibits spend the night in their savannah exhibit. This is what makes the Night Team so important; to monitor work taking place in these exhibits and provide care for the animals through the night. Safari Night Keepers come into work

at 6:30pm and work until 5:30am. After a brief check in meeting, the keepers go to their focus team's barns. There are three day teams that the Safari Night Keepers partner with and they include Ituri Forest, West Savannah, and East Savannah. These teams are broken up based on different areas of the Kilimanjaro Safari attraction. The Ituri Safari Night Keeper assists with shifting and feeding animals including Nile hippopotamus, black rhinoceros, bongo, kudu, yellow-backed duiker, and okapi for the night as well as cleaning their exhibits. West Savannah Safari Night Keepers set up a truck with hay, browse, produce, and grain and will head out into West Savannah exhibit to feed and enrich a large collection of African hoofstock including wildebeest, springbok, eland, Ankole cattle, and giraffe. If staffing allows, there may also be an extra Safari Night Keeper at the barn to assist the day keepers with cleaning and resetting barns as well as shifting animals after the Kilimanjaro Safari attraction closes. The East Savannah Safari Night Keeper will also set up a truck with hay to feed out and head into the East Savannah exhibit that houses white rhinoceros, waterbuck, bontebok, and common zebra. If staffing allows an extra keeper to assist at the barns, they are responsible for working with the East Savaannah day keepers to shift and feed zebra, bontebok, and warthogs around sunset. Later after the Kilimanjaro Safari attraction has closed, the Safari Night Keeper will also help the day keepers to shift in and feed white rhinoceros and African lions. The ultimate goal of the Night Keepers in trucks on the savannahs is to feed and enrich animals as well as keep animals clear of the Kilimanjaro Safari attraction's ride path and to maintain animal visibility for guests. Night keepers in the truck also have the responsibility of collecting data on animal visibility to see which species are the most visible and which species need improvement. To improve visibility of a species, the Night Keeper can offer enrichment in strategic locations. A few species have been trained to come to certain locations to help with making them more visible, this training has also be helpful to move animals out of the ride path to allow the safari trucks continue to run without delays and has also been used to move animals in a positive way when there is construction in the savannah exhibits overnight. Night Keepers are also there for everything beyond the regular routine, including birth watches, bottle feeding and hand rearing, specialized medial checks, post procedure medial checks, and so much more with the ability to crossover with day keepers when the first come in the next morning.

With the ultimate goal of providing a seamless transition into the extended hours of the Kilimanjaro Safari attraction, the Night Team has been there since before construction to launch day and beyond. Building strong relationships with the day animal care teams has allowed the Night Team to expand into more shifting, enriching, and training while working more closely with keepers and animals than ever before. Close partnerships between the day animal care teams and the Night Team has made for an efficient 24 hour animal care operation with the ability to provide excellent animal care and to hold the highest standards of animal welfare.

# Keeping a North American River Otter Breeding Pair Together Through the Birth and Rearing of Four Pups, is it Possible?

**Introduction**- Is it possible?

The Kids Kingdom Animal Keepers of the Pittsburgh Zoo and PPG Aquarium are not new to North American River Otter ("NARO") births, having a combined Keeper experience of over 50 years. Since 2005 there have been four North American River Otter litters born at the Zoo with the most recent being in January of 2018. It had been the experience of the keepers that it was not possible to keep the male NARO in the exhibit after the litters had been born due to extreme aggression and protectiveness from the female and an over interest from the male in both the pups and the female during post pregnancy estrus. With all of the past litters, the male NARO had to be moved to an alternate location and reintroduced at a later time. Due to limited options of available space, stress, age of the male and past reintroduction issues, moving the male out of the exhibit was not an ideal option. However, with limited viable alternatives, the decision was made to try to keep the pair in the same exhibit. Questions were abundant on whether changes to housing/den options, feeding practices, and general husbandry would be sufficient to keep the pair together post birth. With successes and setbacks occurring every day, it was hard to tell what the outcome would be. Is it possible, to keep a North American River Otter breeding pair together for the birth and rearing of four pups?

The answer is Yes! If you have all the right conditions!

There are several factors that lead to our success in keeping our breeding pair together including age and temperament of our North American River Otters, exhibit layout and modifications, and feeding style.

**Age and Temperament**- An Introduction to the Pittsburgh Zoo and PPG Aquarium North American River Otters:

Country is our male North American River Otter. He is seventeen years old and arrived at the Pittsburgh Zoo and PPG Aquarium at the age of two from the Nashville Zoo. He has been in the same exhibit for the past 15 years. Country has had three previous mates and had sired two litters prior to this one. Country's temperament is very sweet and gentle, and he is actually quite fond of attention.

Annie is our female North American River Otter and is newer to the Pittsburgh Zoo and PPG Aquarium; arriving in May of 2016 from Clear Water Marine Aquarium. Annie is 8 years old and had one previous litter while at Clear Water Marine Aquarium. Her temperament is very different than Country's. She is curious and pleasant but not fond of change.

We believe that Country's age had a big impact on the success of keeping the NAROs together throughout the birth and rearing of the pups. With all previous litters, Country had shown extreme interest in the new pups and was removed from the exhibit mostly for his safety, as female NARO's can be highly territorial and aggressive, especially with litters (Reed-Smith, 2001). With this litter Country showed little interest in the den and generally avoided that area of the exhibit. He would give our female a wide birth often traveling way out of his way to avoid getting to close to the den, female, or pups.

**Exhibit Layout and Modification**- addition of new dens, style and placement of dens

The North American River Otter exhibit at the Pittsburgh Zoo and PPG Aquarium is essentially a square, with the front half of the exhibit being a pool with a horse shoe of land around it, and two water falls running from close to the back of the exhibit into the pools. This allows both otters to easily access water without having to cross paths. There is a holding area that is not used by the Otters except for training and feeding, as it is extremely small and the otters do not like denning in it. For previous litters there were only two denning options, a large plastic rain barrel and a fiberglass rock. Due to the small amount of flat land in the exhibit, both den options were in the back of the exhibit, and close to one another. A few years prior to receiving Annie, I had redesigned the den options in the exhibit to help with the NARO's coat conditions. With the help of my colleagues, I removed the plastic rain barrel and fiberglass rock and put in more natural den options in the form of hollow logs. I also increased the number of den options, from two to four, and the style of den to include different sizes, shapes, and positioning. Upon noticing that Annie was pregnant, we realized that all of the den options would either put Country too close to Annie and the pups once they were born or Country would have to travel past Annie to get to the normal feeding location. To resolve this issue, an additional den was placed on the side of the exhibit utilized for feeding. This den was a terracotta pipe that had multiple exits to insure

that if Annie came over for feedings and became aggressive with Country, he would not be trapped in his den. Also, due to the distance between Annie's favorite den and the pool we set up a small tub of water close to her den to drink from, and further prevent unnecessary confrontation.

**Feeding**- free contact and adaptation

Feeding of North American River Otters in most zoos is typically done by non-contact form; being either over a barrier or through a fence. At the Pittsburgh Zoo and PPG Aquarium this holds true for all of the keepers who help take care of the Otters, except myself. Upon becoming the lead keeper and trainer of the NAROs, I received permission from the Kids Kingdom Curator to start in exhibit, free contact, feeding and training sessions. This would prove to be very useful in keeping the peace between our male and female otters once the pups were born. First, it meant that Annie was comfortable with keepers entering the exhibit which allowed for her to be fed while she was in her den and second, it allowed keepers to cross through the exhibit to feed Country on the far side of the exhibit to avoid upsetting Annie while she was in and or around her den.

On the day the pups were born, I was able to enter the exhibit, approach the den and feed Annie inside her den by utilizing a feeding pole made of PVC pipe. I was also able to visually check the pups, obtain a count and take photos and video to share with the other keepers, our curator, and most importantly the veterinary staff. I was also able to observe the pups nursing and note that they were all in good health. I credit the ability to do this to my past choices of free contact feeding and my exhibit cleaning methods. I clean the NARO exhibit while the otters remain on exhibit so they are accustomed to my movement around the exhibit, tools, and myself in general. Using these methods I was also able to create a bond and trust between the otters and myself. That trust being so important, it was decided that for the first week I would be the only person to enter the exhibit to check on Annie and the pups, and to do the feedings. Annie remaining as relaxed as possible during the first week was crucial to her health, the pup's health and Country's health. After the first week, one of my other coworkers would take over the monitoring and feeding on my off days. This was the only other person who had felt comfortable enough to go into the exhibit with the otters and clean with them on exhibit, prior to the birth of the pups.

In the initial days after the pups were born, I was able to feed Country first and then enter the exhibit to feed Annie inside her den. After a few days Country began approaching me as I was feeding Annie necessitating a change in feeding strategy. We determined that it would be necessary to have two keepers feed the otters at all times to prevent altercations between Annie and Country. One person would feed Country while the other would go into the exhibit and feed Annie inside her den. This method was very successful in keeping the otters calm and peaceful. At the one-week mark, Annie began venturing out of the den and would return to her normal feeding location. If Country was in the vicinity she would chase him off. Country was very quick to learn that if he saw her coming to run in the opposite direction. Altercations at feedings between the two usually occurred when he did not see or hear her coming. Our two person feeding method continued to work well, with us often feeding Country either in the pool or on the opposite side of the exhibit from Annie. We often times fed Annie inside of holding, where she could not see Country, so she would remain calm and to prepare for when the pups would start eating solid food.

Once the pups started eating solid food, we would secure Annie in holding and feed her most of her food. We would then feed Country while I entered the exhibit to offer food to the pups inside the den. Once the pups were done eating I would exit the exhibit, feed Annie the rest of her food and allow her back into the exhibit. Initially, she was very nervous, often huffing and growling while eating, but very quickly got used to the process. We continued this process until the pups were big enough to come over to the normal feeding area and eat through the fence. Once that occurred we very quickly moved to feeding them in holding with Annie. Annie's displeasure with Country being near her or the pups dissipated over time and we were able to move his feedings back to the normal location.

Now that the pups are almost the size of their parents we lock them into holding with Annie for feedings. This benefits Country as the pups do not hesitate to block him from getting any food, but we also quickly realized there is less fighting between the pups if they are feed in an orderly fashion through the fencing, in close quarters.

**Setbacks and Surprises**- occasional fights, protectiveness, the baby sitter effect, and the swimming tub

There was occasional fighting between Annie and Country that was almost always instigated by Annie. These fights resulted in several minor wounds including lost toenails for Country and a broken canine tooth for Annie. Most of the fights occurred due to territorial conflicts driven by Annie and her overall maternal instincts. We do believe one fight between Country and Annie was a result of Annie going into post partum estrus roughly two weeks after giving birth. But we believe Country's age discouraged him from continuously pursuing her even during that estrus.

One of the surprises we encountered was her protectiveness of myself. When in the exhibit she would stick close by while cleaning and moving around the exhibit. If Country got to close to me, due to his affectionate nature, Annie would become aggressive towards him. Another surprise we encountered was what we call the baby sitter effect. In the days right after giving birth we started to notice that Annie would come out of the den to urinate and defecate when I was near by. Then not long after she started coming out of the den and swimming in her water tub when I was near the den. Eventually she started going down to the main pool and swimming laps while I was near the den, but was not seen swimming at any other time. We believe she looked at me as a trust worthy baby sitter and took the

opportunity of my “baby sitting” the pups while she got a much needed break. As the pups grew and got used to me, she would often lie down and sleep a few feet away from me while I played with the pups. The drinking tub soon became the pups swimming hole and was where they learned how to swim. We eventually had to remove the tub to encourage the pups to go down to the main pool to swim.

**Conclusion**- If you have all the right conditions!

The possibility of keeping a male and female North American River Otter together for the birth and rearing of pups is extremely risky and should only be attempted with great caution and under ideal conditions. For the Pittsburgh Zoo and PPG Aquarium, several conditions lead to our success. First, and what I believe is the most important factor was the age and temperament of our NAROs most importantly our male Country. Country is 17 years old and has fathered previous litters meaning he is acclimated with the behavior of a female otter post-pregnancy and the behavior of a litter of pups. Annie, being 8 years old and delivering her second litter, was also helpful in that she was not a first time young mother who might be more aggressive and territorial. The second condition that helped in our success was our exhibit layout and addition of multiple dens. The layout, with a large pool and two waterfalls, gave both otters easy access to water and escape routes into the pool. The addition of multiple dens, especially ones with multiple access points, allowed our male to have a safe place to find shelter and easily escape our female should she pursue him. The third condition was our willingness to go into our exhibit to clean and feed the otters free contact and adapt our feeding style as the pups grew. My work with the NAROs prior to pregnancy in the exhibit established a trust bond that proved very useful for monitoring all of the otter’s health and the pups growth and development. Despite some surprises and minor setbacks, we were able to successfully keep our North American River Otter breeding pair together for the birth and rearing of pups. In time, Annie let Country near the pups and he is often seen playing with them, looking much like a pup himself. Due to his age he does however require long naps post playtime to recover. Relations have also returned to normal between Annie and Country and they can be seen grooming each other and exhibiting similar behaviors of that prior to the arrival of the most recent litter of pups.

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# What to Expect When You're Expecting: Ultrasounding a Francois' langur

***Sarah Doherty, CHINA Keeper, Memphis Zoo***

**Introduction:**

Francois' langurs (*Trachypithecus francoisi)* are an endangered species of monkey from China, Vietnam, and Laos[2]. They are in the Old World monkey family called Cercopithecidae and live in troops typically from three to ten individuals[2]. The gestation period typically is six to seven months, with a year and a half in between infant births.

In mid-2017 Memphis Zoo had 2.4 Francois' langurs. "Jean Grey" (0.1), seven years old, had suspected difficult births in her first two pregnancies where both infants were found alone at the front of the den in the morning by keepers. Both langurs were larger than the normal size (450-500g[1]) of an infant langur, with "Phoenix" and "Rook" weighing 567.5g and 552g respectively. For comparison, a female infant langur in 1995 at San Diego Zoo weighed 406.9g and a male in 2016 at Los Angeles Zoo weighed 463g at birth[3].

Jean Grey's first pregnancy necessitated an attempt to hand rear the baby, but unfortunately the infant passed away after approximately three months. Jean Grey's second birth required the infant be retrieved from the floor of the den, warmed and given fluids, and then reintroduced to her mother the same day. Jean Grey accepted and raised her successfully. However, because this female is recommended through the SSP for continued breeding with our current male, animal and hospital staff prioritized enhanced preparations for her next birth, including training for ultrasound participation. Voluntary ultrasound training using operant conditioning with smaller primates can be extremely valuable especially with less experienced females that may have challenges giving birth and successfully raising young.

*Jean Grey's First Infant: Phoenix*

*Jean Grey's Second Langur Baby: Rook*

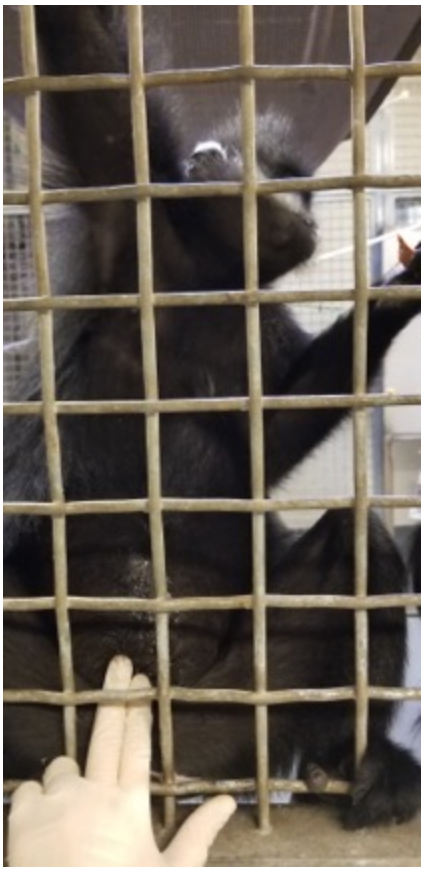
**Objective:**

To prepare for Jean Grey's next birth, department keepers wanted to train Jean Grey to participate in voluntary ultrasound procedures with senior veterinarian, Felicia Knightly DVM, to predict a birth window and prepare for any potential birthing complications. Along with training, cameras were installed in the langurs' dens to review footage of the birth. An incubator was installed in the building in January and maintained at the appropriate temperature.

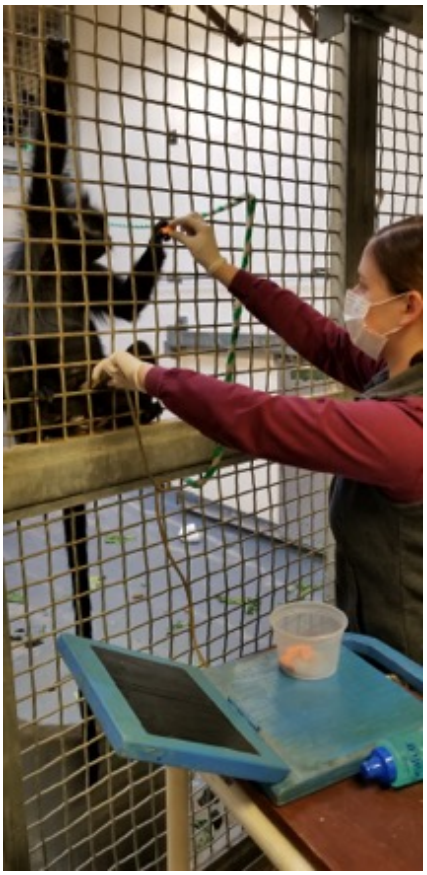
**Methods:**

Training began in June 2017 with just the primary trainer (Sarah Doherty, CHINA Keeper) in the service area. All training was done protected contact. Initially, just the male was separated away from Jean Grey, while the other

adult female and three juvenile langurs stayed in the same den as her. She quickly progressed to where the keeper touched her stomach with two fingers and allowed for application of ultrasound gel. With each repetition of training, the langurs including her one-year-old daughter, became more comfortable with being separated from Jean Grey.



*Applying Ultrasound Gel to Stomach*



*Mock Ultrasound Machine*

The trainer used a mock ultrasound machine, which took some desensitization training to be able to touch the wand to her. Ultimately keeper and vet were able to move directly into using the real machine for imaging because of this desensitization step.

Other familiar keepers then began to stand in the service area, and finally unfamiliar keepers, while training occurred to desensitize Jean Grey to having a vet and a vet tech in the room. All keepers in the department regularly asked for the basic "belly" behavior from her and would touch her stomach as well. Jean Grey readily offered her stomach to anyone that asked because she was highly food-motivated. The reward used for all langur training at Memphis Zoo is sweet potato.

During the first session with the vet Jean Grey was slightly unsure, but she eventually came to the front and allowed the vet to touch her with the actual ultrasound wand before the end of the session. While the vet performed the procedure, the trainer rewarded and watched Jean and the vet tech took stills and videos during the procedure. Near the end of each session the vet offered rewards to Jean Grey to always end on a positive note.

*Ultrasound Procedure*

After a few weeks of working out the depth (8.2cm) and where to use the wand on her stomach we began skull measurements. When skull measurements were recorded, they were done live. The ultrasound was paused and measurements were taken. Jean Grey waited at the mesh for the occasional reward and was ready to continue after measurements. Measurements taken included the skull width and circumference.

**Results:**

The first real ultrasound with the vet and vet tech was September 23, 2017, where there was no indication of a fetus. The next ultrasound was October 25, when a fetus was documented.

*First Ultrasound of Fetus*

From then on, weekly ultrasounds were done and live skull width measurements began on December 16 to predict birth window based off information given from Toledo Zoo on their Francois' langurs' ultrasounds. The first circumference measurement was taken on December 30 (Table 1).
A birth window was predicted for the month of January, because of the uncertainty of the breeding date, due to the male continuing to breed Jean Grey throughout summer and fall. Because this was the first time doing ultrasounds the vet was also unsure of how large the fetus would become before giving birth. Preparation began for birth while continuing a weekly ultrasound routine to support Jean Grey's trust in the vet and keep her used to training with an actual machine and multiple people. Her primary trainer supplemented with the wooden ultrasound machine at least once a week as well.

**Table 1:** Width and circumference of the head of gestational infant inside Francois' langur Jean Grey at Memphis Zoo 2017-18.

| Date | Width | Circumference |
|---|---|---|
| Dec 16 2017 | 4.27cm | |
| Dec 16 2017 | 4.62cm | |
| Dec 16 2017 | 4.66cm | |
| Dec 30 2017 | 4.81cm | 13.0cm |
| Dec 30 2017 | 4.91cm | 12.8cm |
| Jan 6 2018 | 4.98cm | 14.3cm |
| Jan 13 2018 | 5.00cm | 14.8cm |
| Jan 27 2018 | 4.83cm | 17.5cm |

Important measurement information to be aware of is the head orientation inside the uterus. The skull size could possibly be measured differently each time based on orientation of the fetus, so width and circumference can vary. Circumference was more of a constant measurement based on what was found (Table 1).


*Width of Skull December 16, 2017*

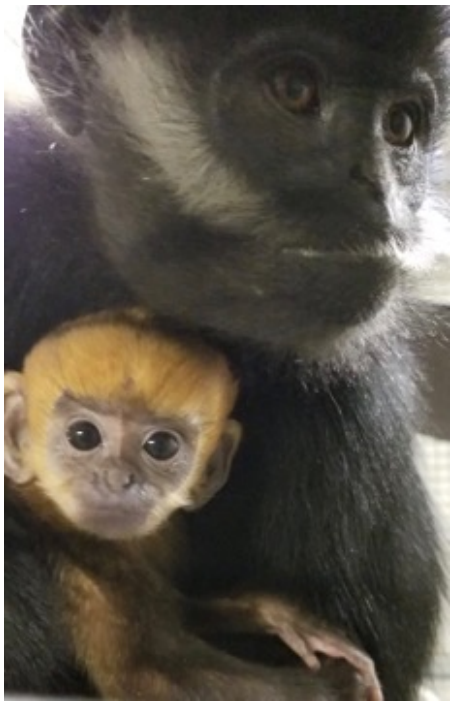

*Circumference of Skull December 30, 2017*

On December 6, a change in position of the fetus was seen on ultrasound and the spine was no longer visible, but it appeared in later ultrasounds. January 13, 2018, the head had moved down to the pelvic area. Near the end of the pregnancy Jean Grey became touchier about her stomach and it was harder to put ultrasound gel on her with fingers, but after a few tries she would become tolerant and allow gel applied with the wand. February 17, the head was no longer visible on the ultrasound for the first time due to fetus orientation.

The infant was born overnight between February 19-20. The camera in the first langur den was helpful in determining a smaller birth window after reviewing camera footage the next day, but Jean Grey had the baby out of sight of the camera in another den or hall. When keepers came in the next morning they found her holding the baby. This was unlike the previous births Jean Grey immediately and appropriately held the newborn. Compared to previous births, there was a relatively small amount of blood in the dens.

The day after giving birth, the primary trainer asked for Jean Grey's stomach and she came down and offered it even while holding the baby, Reagan. This aided in determining the gender of the baby (as a female) and would have proven useful if the baby needed any supplemental feeding or care.

*Day After Birth*



*Jean Grey and Reagan*

**Conclusions:**

We were able to successfully have a Francois' langur participate multiple times a week in an ultrasound procedure with the vet. The senior veterinarian put a strong emphasis on the importance of building and maintaining trust among the langur, herself, and the primary trainer. This training was critical in helping aid in the care and husbandry of our pregnant female and allowed for valuable neonatal assessment. Jean Grey is the first monkey at Memphis Zoo to participate in voluntary ultrasounds, which are more commonly used for apes. It allowed us to get valuable data about skull size and the development of bones and organs during a pregnancy. The next pregnancy will allow us to gain even more information and allow for a better prediction of the birth window.

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I like the Ultrasound of That
She's Not Fat: The Zuri Warthog Story
Stephanie Shop
Columbus Zoo and Aquarium

Abstract

In 2016 The Columbus Zoo's Animal Programs department welcomed its first litter of 1.1 baby warthogs; birthed by first time mom, Zuri, in the early morning hours, staff were ecstatic to find two healthy baby warthogs. Having confirmed definite pregnancy just 48 hours prior to Zuri giving birth, staff scrambled to have all the essentials ready and learn what we good about preparing the house, staff and mother to be for the arrival of the babies. In the months leading up to the birth staff had not noted any outward signs of pregnancy and having seen no copulation with our male we only decided to call our vet staff after noticing Zuri's stomach looking a little larger than normal. While our warthogs are trained to a variety of behaviors an ultrasound was not in their repertoire so to confirm pregnancy we continuously fed Zuri and after several attempts a few days apart we were able to confirm that she was pregnant; 48 hours later we were greeted by two piglets. Feeling rushed and not as prepared as we wanted to be, the staff decided after the birth of this litter that we would train an ultrasound behavior on our two female warthogs which our vets would put to good use when just over a year later we were able to confirm pregnancy of Zuri several months before the birth of her second litter. We are now able to ultrasound our warthogs every few months to check for potential pregnancies; not only has it prepared our staff for these events, we are also allowing our warthogs to choose to participate. With the surprise of our first litter, we saw the need for a change and for the for the staff at the Columbus Zoo, it was a simple choice to train this behavior and make the lives of all involved a little easier.

Background

The Columbus Zoo is home to three warthogs; two females, Binti and Zuri, who came to Columbus in 2012 when they were just a few weeks old and were hand raised by the Animal Programs staff. Before moving to the Columbus Zoo's newest region, "Heart of Africa", Binti and Zuri were trained to walk on harnesses through several regions of the zoo, acting as animal ambassadors. Our un-castrated male, Randall, came to us when he was four years old. He was acquired in anticipation of the "Heart of Africa" region opening in 2014. With the newest region of the zoo getting set to open in May of 2014 and our animals having just moved into their new homes, a lot of time went into making sure the animals were comfortable in their new enclosures, shift-ways, and yards. During this transitional time we focused on working the warthogs in two separate groups the females together and the male alone. We began training the warthogs in their new home starting with a scale behavior and quickly followed by training them to shift into their new exhibit space.

Shifting is a very important behavior for all the animals that call the watering hole in the “Heart of Africa” region home. This particular exhibit space is rotational, in that, animals shift in and out of the space throughout the day. To ensure the warthogs would shift through roughly 150ft of shift-way a lot of time was spent working on the two groups to solidify the behavior. Once the shifting behavior was solid our team began to talk about the possibilities of introductions with all three warthogs and as a plan was set we moved forward with introductions in the watering hole exhibit. The introductions went smoothly with no discernible aggression seen by any party. The females seemed to avoid being close to Randall so we decided to continue housing them separately when they were off exhibit. The only time all three warthogs were together was when they had access to the watering hole. The “Heart of Africa” region is seasonal, usually remaining open from April-early November. While the warthogs continued their encounters in the watering hole, once the season ended we had still not seen either of the females showing an interest in being near Randall.

Due to a particularly tough Columbus winter the warthogs had little access to the watering hole and when they did it was for short periods of time. During this period of time and after a substantial weight-gain by Randall, staff decided we would begin working him in a protected contact manner. Because our staff had not been around him from a young age we felt our team could better cater to his needs by using protected contact methods. Moving into our second season we brushed up the warthogs on their shifting and began consistently sending Randall and the girls out to the watering hole together. There seemed to be no change in behavior between them; the girls would spend time on one side of the yard and Randall on the other. With a mild winter in 2015 all three warthogs were able to go out together several times through the month of November.

Something’s Different

The 2016 “Heart of Africa” season began in April and the warthogs continued to shift to the watering hole together. Still, we saw the females continuing to prefer to spend their yard time by themselves with Randall doing the same. In late April, staff noted that female Zuri looked a little larger than normal. Joking that she might be pregnant, we decided to weigh her and discovered no significant change. Considering the fact that she was within her normal weight range and since staff had never observed Zuri within ten feet of Randall, we pushed the thought to the back of our minds. A few weeks later staff began to notice changes in Zuri, her nipples and vulva looked swollen and enlarged. With these changes we decided to contact our animal health team. Once the veterinarians were looped in they decided to perform an ultrasound; this posed a small problem for us because while we work free contact with our females we were not sure how they would respond to vet staff.

After coming up with a quick plan, we had our vet stand outside of the enclosure, performing the ultrasound through a slightly cracked door while our team continuously fed Zuri. While she was somewhat willing to participate, she moved around quite a bit and subsequently vet staff found nothing on the ultrasound. Our staff felt comfortable with this diagnosis because we had not seen any breeding behavior from the warthogs. When Zuri’s stomach continued to look larger and her nipples continued to increase in

size, however, we asked the vets to attempt a second ultrasound. To help accommodate vet staff with this ultrasound we decided to see how Zuri would respond to them stepping into her stall with us while we fed her. The process was long, and we had to continuously feed Zuri. By the end of the exam, our vet felt certain that she had seen something that resembled a fetus. With this sighting we felt the need to confirm 100%, as our vet felt that the fetus was large and Zuri was potentially very far along in the gestation. Using our highest value reinforcers, watermelon and honey, we were able to station Zuri in a position and occupy her with food long enough to allow us to get a clear picture of two warthog fetuses.

With confirmation that Zuri was pregnant our next question for animal health was, “how long do we have until she gives birth?” Based on the size from the ultrasound, our vets felt that we had 7-10 days to prepare. However, Zuri had other plans and not even 48 hours later, she gave birth to two piglets. The babies were discovered during a late-night check. Having seen some slight behavioral changes in Zuri during the day our staff decided to separate her from her sister and set up her enclosure in accordance with standard birthing parameters using information we were able to quickly obtain from several zoo contacts.

## Changes

Considering the rushed and unprepared nature of the first arrival of piglets, it was decided that we should train an ultrasound behavior that we could employ every few months to check both of our females for potential pregnancy. We felt this behavior was important to train because despite having docents and volunteers watching our animals we had never seen any copulation. When discussing the logistics of the behavior we were unsure how Binti would respond to animal health staff. While Zuri was tolerant of the vets stepping into her stall we did not feel that Binti would tolerate those same circumstances. To make sure that everyone could be involved, including Binti, it was decided that we would train the behavior so that our animal health staff could perform the ultrasound from a protected area.

## Practice Makes Perfect

In our Animal Programs building, in what we call our “mixed-species wing,” there are seven adjacent houses-all connected by guillotine doors that open from side to side. Staff decided to train the ultrasound next to a guillotine door so that it could open and close for animal health staff to access the warthogs. Using an ‘L’ shaped station, with the front portion being at a 90 degree angle. We taught Binti and Zuri to station their legs on the bottom portion and then they would touch their chest to the portion sticking up from the ground. Using a station allows us to move it around and the warthogs know if they see it that they are to step onto it no matter where it is placed. To train the station we started with a cinder block to act as a chute to help guide the warthogs into place. We would reinforce the warthogs for walking onto the station and as they started to come in more consistently we moved the cinder block away. However, we kept it on the station to help hold it in place so the warthogs would not push the station. Once the

warthogs were coming into the station we began working on duration, reinforcing intermittently for standing in place.

Once they were trained to station, we started the ultrasound process. The first step was training the warthogs to stay in the station when the guillotine door opened. Normally we would use the guillotine door as a cue for the warthogs to shift from side to side. To signify that the station behavior was different than shifting we started with moving the door handle and if the warthogs stayed in the station we would reinforce them. As the warthogs began to understand that the station and the door were coupled together we moved on to light touches from a second trainer, who was positioned on the other side of the guillotine door. Once the warthogs were comfortable with touches from our hand, we moved forward using a fake ultrasound probe and even desensitizing them to the ultrasound gel. When it appeared that the warthogs seemed ready, we invited animal health staff to come to our building and practice using the actual ultrasound machine. We noticed during this training session that while Binti had been comfortable during practices she seemed more hesitant to step into her station and stay in position once the animal health staff started the ultrasound process. Having this information we went through more practice sessions, using a fake ultrasound computer so that we could replicate the actual ultrasound as closely as possible. These approximations seemed to help and both warthogs participated in future training sessions with animal health staff.

While we had decided the ultrasound was something we wanted to train so that we could feel prepared the next time we were suspicious that one of the warthogs was pregnant, we did not realize how quickly we would be able to put the ultrasound behavior to practical use. For the first time since the warthogs had all been together, staff witnessed copulation. Using this information and after discussions with animal health, we decided to perform an ultrasound three months after copulation and were able to confirm that Zuri was pregnant with her second set of piglets. Binti was also examined during this time and was determined to not be pregnant. While vets were performing this ultrasound they asked us to begin working the warthogs on getting used to the ultrasound on the opposite side and asked if we could train them to stand for an x-ray. They hoped that by training these behaviors we could better determine the number of piglets, which would, in turn, help staff better prepare for their birth.

To train the second side of the ultrasound we applied the same principles as we had for the original side. This process moved quickly as we just had to get them used to touching on the new side as they were already trained to stand in the station. To train the x-ray, our staff built a contraption that would safely hold an x-ray plate. We used the station and trained the warthogs to stand in a stationary position while we moved the plate in and then opened the same guillotine door used to allow the vets to access the warthogs during their ultrasound. The most important part of this behavior was having the warthogs stand completely still so that the vet staff could capture a clear image.

Again, once we felt that the warthogs were ready we had vet staff come up to put the training to the test. Zuri was receiving regular ultrasounds so we could track the development of the piglets and the x-ray behavior was used as-needed, determined by

vet staff. Feeling much more prepared for our second litter of piglets; animal health staff was able to predict almost to the day when Zuri would give birth and in mid-October of 2016, we were greeted by a male warthog piglet in the early morning hours.

Maintenance and the Future

Training our warthogs to participate in the ultrasound behavior has allowed us to monitor our warthogs for pregnancy and was again, most recently, put to good use. After seeing Zuri breeding with Randall we performed an ultrasound and discovered she was pregnant. During this ultrasound we also had the vet staff practice on Binti even though we had not seen any breeding between her and Randall. To our surprise, however, Binti was determined to be pregnant as well. By using the ultrasound behavior our vets were able to correctly determine who was farther along in their gestation. In May of 2018, the Columbus Zoo was greeted by three warthog piglets from mom, Binti, and three days later Zuri gave birth to four more piglets.

Though the decision was made to castrate our male, Randall, after it was determined that both females were pregnant, we feel confident that this ultrasound behavior will still come in handy in the future. This behavior could potentially prevent us from having to anesthetize them to perform a medical exam. We can apply the training methods used for the ultrasound behavior to perform hoof check-ups, blood draws and x-rays on multiple parts of their bodies. Not only did the ultrasound behavior inspire the need for an x-ray on the warthogs, but, we were able to apply the same training techniques and tools to x-ray train our cheetahs allowing us to minimize how often we have to anesthetize our animals.

Training these behaviors empowered our warthogs to participate, in a deliberate way, in their own medical treatments instead of just manipulating behaviors by distracting them with large amounts of food. It also helped our staff to better care for our animals and to better prepare ourselves and the animals for whatever the future might hold. This was an easy decision for us to make a simple change that would help us and more importantly, the animals we care for. The animal care field is constantly changing and as our warthogs and all the other animals we care for continue to present new challenges, we look forward to rising to them and finding new solutions to continue giving our animals the voice they deserve.

# *Hand Raising A Southern Three-Banded Armadillo*

**By Jessica Biggins**
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On January 8, 2018 the supervisor of small mammals received a phone call from the night keeper at 1:30AM saying a baby southern three- banded armadillo was born. This was great news but there was some bad news, the dam was tossing the baby around and wouldn't stop. The supervisor ran to the zoo immediately to save the baby from its mother. The dam had done the same thing to her last baby, which we were unable to save. Raising a baby armadillo is not an easy task and hasn't been done successfully very many times. We started to pull information from as many resources as possible to give this baby a fighting chance. The baby was a female and weighed 76 grams at birth. She was given the name Miracle, Mira for short, since it was a miracle the night keeper found her at the right time before the dam could do any damage to her. It has been a roller coaster ride raising Mira and we are all very proud of all that's been accomplished. With that being said, there is still more work that needs to be done to try to avoid some of the medical issues we have seen during this process.

We knew the dam was pregnant and had a history of rejecting her babies so we had hand-raising protocol in place and everything ready if it was needed. Once the supervisor had the baby in hand she started this protocol. The incubator was turned on and set to 85 degrees, a heating disc covered in a towel was placed in one corner of the incubator, and fluids were given to Mira. Formula was made and warmed to 95-97 degrees. Over the course of raising Mira, we went through 9 different formulas. The first formula was 1 teaspoon of Esbilac, 2 teaspoons of distilled water, and 1 teaspoon of heavy whipping cream. We used this formula with different ratios of ingredients until day 9. At day 9 we changed out the heavy whipping cream with full fat Greek yogurt. We also added some vitamins to the mix. At day 10 we changed formulas more dramatically. We changed to using Clinicare and casein powder along with some vitamins. We used this formula until day 36 and changed to Purina Pro Plan Feline chicken and liver entree, Clinicare along with the vitamins. From day 36-day 50 we were noticing some dents in Mira's shell so we thought she needed more fat in her diet so we added full fat Greek yogurt back into the formula. She would get a dent on each side of her head toward the front of her shell and also one on her rump. When we noticed the dents increasing in size we would add full fat Greek yogurt to her formula/diet. We kept playing with the formula until we finally landed on a mixture of Purina Pro Plan cat food, full fat Greek yogurt and soaked insectivore diet. This formula will be what we use to wean her onto an adult diet. She should be weaned at day 72 but the weaning process will be delayed due to medical issues. We are able to easily add vitamins and supplements to the canned cat food so until the medical issues are resolved, this will be her primary diet. At day 67 we stated to add bugs to her diet. We started by offering her the guts from crickets and wax worms. By day 81 she was eating legless crickets and wax worms cut in half. Today she gets her bugs whole.

The amount of formula she was given was determined on her growth rate and the amount she would take at a feeding. We also tried many different ways of feeding her, from tube feeding, feeding out of a syringe, and offering food in a dish. When she was first born she wouldn't eat from a syringe or a nipple so she was tube fed. We would try the other methods prior to tube feeding her just to see if she was ready to eat on her own. On day 9 she started to eat formula from a dish. Again, she had medical issues periodically so if she wouldn't eat on her own, she would be tube fed. One of these times was from day 22 to day 29. Mira wouldn't eat on her own so she was tube fed. During her research, the supervisor had read that the best way to nurse a baby armadillo is to lay them on their back since they would naturally nurse this was from their mother. It worked like a charm; she was taking food from a syringe while lying on her back. This led her to get stronger and on day 32 she was consistently eating from a dish on her own. As she grew up the number of feedings she was receiving also changed. From day 1-35 she was getting 6 feedings a day. On day 36 we dropped one feeding. Currently we are feeding her 3 times a day.

During our research on how to care for Mira we came across a typical growth pattern for an armadillo. A baby should be born around 113g of weigh, have slow growth until day 12. Between days 12 and 17 there should be a spurt of growth with a weight around 200g at day 16. After day 17 there should be steady growth from there on out. Needless to day, Mira didn't follow this pattern. We had a number of set backs during her development that did affect her growth rate. We also feel the formula we were using isn't quite right and still needs some development. Below is a table showing her growth in weekly increments from day 1 to the day I pulled information for this paper in early August.

| **Day 1** | 76g | **Day 112** | 764g |
|---|---|---|---|
| **Day 7** | 86g | **Day 119** | 777g |
| **Day 14** | 111g | **Day 126** | 802g |
| **Day 21** | 187g | **Day 133** | 831g |
| **Day 28** | 259g | **Day 140** | 833g |
| **Day 35** | 342g | **Day 147** | 861g |
| **Day 42** | 402g | **Day 153** | 872g |
| **Day 49** | 465g | **Day 160** | 881g |
| **Day 56** | 507g | **Day 167** | 890g |
| **Day 63** | 528g | **Day 173** | 917g |
| **Day 70** | 576g | **Day 180** | 927g |
| **Day 77** | 627g | **Day 187** | 946g |
| **Day 84** | 657g | **Day 193** | 942g |
| **Day 91** | 679g | **Day 200** | 980g |
| **Day 98** | 711g | **Day 207** | 986g |
| **Day 105** | 751g | **Day 214** | 1006g |

Many physical changes were noted during her early development. On day 14 we noticed her shell was starting to harden. By day 14 her toenails were formed and becoming hard. On day 19 the vet could no longer hear her heart and lungs through her shell since it was hardening up. On day 20 her skin was changing from a pink color to the adult tan color. She was also growing hair all over her body during this time. Mira's eyes also opened up on day 20. She needed some time to adjust to being able to see, we were all scary creatures to her. Just as she was adjusting to seeing, her hearing also kicked in on day 21. She was a little shy until she adjusted to her newly acquired senses. We noticed she seemed to be regulating her own body temperature around day 18. She wasn't relying on her heating disc as much to stay warm at this point. Armadillos are very easy to sex, even at day 1 so we knew she was female from the very beginning.

Poor Mira had a lot of set backs as she was growing up, and some continue to this day. On February 27, day 51, we thought we were going to loose Mira. The night keeper found her in a balled position and wouldn't open up to eat. She stayed in this balled position for 4 days. During this time she also had explosive diarrhea. On February 27 she was rushed to the Animal Care Center for x-rays, blood work, fluids, vitamins, pain medications and antibiotic injections. Tube feeding began again at this point as well. There were no improvement seen in a couple days so she was taken for an MRI and CT scan. The dam was used as a comparison in the tests. Both tests came back normal leaving us all to wonder what was going on with Mira. On day 54 she was still in the balled position and with no results from the MRI or CT tests we decided to give her some anti-nausea medication and a fecal transplant. The fecal transplant consisted of 12 ml water, 3 ml fecal from the sire, and some full fat yogurt. The theory behind this treatment was she had something going on with her stomach resulting in the bad diarrhea and not wanting to eat. Fecal transplants have been successful in correcting digestive problems in people and other animal species so we thought we would try it. Later in the day she did open out of the balled position and ate a little food on her own from a dish. The next day she was balled up some but acting more normal. By 1 pm she was up walking around, not well but she was up. She wasn't eating enough to sustain her so she was tube fed to supplement what she would eat. We were also making sure she was getting some exercise to help her build her strength back up. By day 67 she was improving but still not back to normal. She was given another fecal transplant via tube feeding. Two days later she was well enough to be put in her playpen area to run around, she was back out of her incubator! We weren't able to pin point what the problem was during this time period and what helped to correct it.

At different times we would notice she had weakness in her legs. Her right front wrist would bend, she would fall over and not be able to right herself and she would use her tail to balance by using it as a fifth foot. Around day 108 she was having a lot of troubles with all her legs and having trouble eating. Mira was taken to the Animal Health Center for an exam, x-rays and blood work. The results showed weak bones, she wasn't getting enough calcium. During this time we had to revert to tube feeding her as needed because of the bone loss she was unable to eat on her own, she

couldn't chew. We adjusted her diet by adding more calcium and exposing her to UV light either via a bulb or taking her outside. In four days, on day 112, we were seeing some improvements. She started to stand on her own, started to eat from a dish but was still unstable so we would have to hold her up to eat. After the adjustment to her diet we continued to see improvements in her walking ability. By day 121 she was nearly back to normal. On day 134, the vet rechecked her by checking her blood levels and x-rays. Her blood levels were improving and her bones appeared stronger in the x-rays. By the end of July she was moving around like a normal armadillo! Her bones still aren't normal at the time I'm writing this paper but she is able to get around well. We have increased her time outside in the sunshine for UV and are looking into a different type of calcium supplement.

Outside of our goal to raise Mira into a healthy adult armadillo, we also wanted her to live with the dam on exhibit. Once she was healthy enough to be allowed into her playpen, we started to introduce the dam to Mira in the playpen. We would let Mira run around the playpen for a little bit before bringing the dam to the playpen. We watched very carefully and never left them alone during the initial introductions because we knew the dam tried to get rid of Mira before. They would investigate each other for a brief moment and then go about their business. They really didn't care too much about each other. We would increase the amount of time they were together until we felt they could get along without supervision. In the middle of July, Mira graduated from her small exhibit to sharing time with the dam in the large exhibit on the nocturnal side of the building. At the time of writing this paper in early August they are sharing the exhibit from 11AM-4PM and be separated for the other portion of the day. This separation is mostly due to the fact Mira needs time to eat her food since she's on a different diet than the dam. All and all, the introduction of Mira and the dam were uneventful.

Raising a baby southern three-banded armadillo has been very challenging but rewarding. There were many times we didn't think she would make it but she pulled through each set back. There were a lot of people involved in the process including the small mammal, veterinary and night keeper staff. We also pulled information from other institutions, private sector rehabilitation facilities, and nutritionists- it took a village to be successful. At this point we have successfully raised her but we did have set backs so work still needs to be done on the process. If anyone is in the same situation as we were please contact us and help the zoological field keep this process moving forward until we get it right. These animals are great animals and deserve the best care we can give them. By working together I think we can get there.

# Fixer Upper: Training Program Edition

Heather Ward, Carnivore Keeper, Saint Louis Zoo

Developing and implementing a training program in the zoo setting can be challenging. Add in a diverse group of keepers, potentially dangerous animals, and years of training with no exact protocols guiding them and it can be a recipe for chaos! There were no training records, protocols, or plans; and all behaviors that had been or were being trained were only communicated verbally or in anecdotal stories. I started as a full-time keeper in the carnivore unit in spring 2013 and shortly thereafter was tasked with writing a training program for the unit. In early 2014 our training program was deemed as needing an overhaul, especially in regard to safety. Frustration and anticipation grew during the down time as the unit's focus was opening new bear habitats and training took a backseat, but a new program was implemented in early 2016. We designed our new training program with two foci: animal welfare and trainer/animal safety.

The Carnivore Unit Training Program seeks to improve the care, husbandry, and welfare of animals through positive reinforcement focused, operant conditioning based training. In order to ensure safety, continued progress and consistency in animal training a formal written training protocol has been developed. Training may be utilized for multiple purposes including medical care, general health, animal husbandry, mental and physical stimulation, enrichment, social interaction, encouragement of natural behaviors, and staff development. The training program is based first and foremost on safety of staff and animals, and should be sensitive to dynamics of social groupings, the natural history of the species and the specific individuals in a group. The goals of the program are: structure, training and support with development of operant conditioning skills and knowledge for the staff; ensuring comprehensive safety of staff and animals during all training sessions; that animals are given choice and opportunities within the training program; allowing more frequent and thorough observations of

animals; relationship building and improved human-animal relationships; providing enriching mental stimulation and reduction of stress for animals; facilitating team and communication building for the carnivore unit; to establish management behaviors that improve routine care; developing medical behaviors that will be set as goals and prioritized yearly by all pertinent staff.

The training program is based first and foremost on safety of staff and animals. The first protocol we established is titled “Approved Feeding Methods for Carnivore Unit”. Knowing that food is the most commonly used primary reinforce used in training the zoo’s animals, our unit focused on establishing safe feeding guidelines that had not been in print before. Overall safety guidelines are that all feedings must be conducted while facing animals and standing at a distance of no closer than twelve inches from the mesh, a safety distance of six inches must be maintained between the trainer’s hands/body at all times when offering food via feed sticks, tongs, feed chutes, or spray/squeeze bottles. Also, when using feed chutes, keeper’s hands must not enter the chute. These approved feeding methods are used for all animal feedings, not just during training sessions. Creating body and situational awareness during training sessions was a new practice to the unit, but the most important to establish safe training setups. Body position protocols also dictate that the trainer cannot touch or cross the mesh barriers at any time whether feeding or not. Along with maintaining safe distances from the animals, the protocol also stresses the importance of evaluating the animal’s behavior, posture, and overall attitude prior to feeding in order to avoid inadvertently reinforcing undesired behaviors. Lastly, the protocol prohibits what we have defined as “split-focus” meaning the trainer must be focused on animal’s mouth when providing food reinforcement and not looking at any another body part.

All training with carnivores is protected contact, meaning that at no time will a trainer and an animal share space or come in direct contact, nor will any part of a trainer’s body break the containment plane and food delivery methods will be used that maintain a safe distance from the containment mesh.

Although we work in with giant anteaters, capybaras, cheetahs, and prairie dogs, these species are still trained and fed using protected contact similar to other carnivores in the unit (felids, ursids, canids, etc.). Training in protected contact with animals we routinely work in with prevents situations where trainers could push animals past their comfort zones and allows the animals the choice to leave a training session without fear of pursuit. As a result, it facilitates better human-animal relationships and builds an animal's confidence as it controls the interaction. When training red pandas, trainers are allowed free contact hand-feeding off habitat, but animals are not permitted to climb on or grab trainers.

It is the primary trainer's responsibility to be vigilant about trainer and animal safety when working on a new training plan. Safety starts with the submission of a training proposal when a trainer wants to start shaping a new behavior. We use a pre-made zoo-wide submission form that we first submit to other keepers in the unit for evaluation and feedback. These forms allow for comments on safety, along with identify cues, bridge, criteria of behavior, and reinforcement. All behaviors listed in our unit's training resource are listed with already established visual and/or verbal cues and behavioral criteria. This allows for consistent communication not only between trainers, but also to the animals. Once evaluated by fellow trainers, the submission goes to the zoological manager and curator for final approval before training can begin. There are safety checks that occur during the check-out process by the zoological manager and safety is always evaluated by other keepers observing another trainer's session. The trainer is also only allowed to train behaviors in the tier they are approved to work in. Only full-time staff is allowed to train new behaviors, but established behaviors can be generalized to part-time or seasonal staff that is approved to work on the routine the animal resides in and after passing a skills assessment exam.

The carnivore unit classifies behaviors into four tiers based on skill levels. Tier zero behaviors can be practiced by any keeper and are early husbandry behaviors such as shifting, accepting different methods of feeding, and voluntary weights. Tier one behaviors are foundational training behaviors such as target, station, body positioning, and emergency recall. In order for a keeper to submit a training plan for a tier one behavior he or she must be checked out to work the routine in which the animal is and must demonstrate that the animal will accept reward using approved methods. Tier two behaviors move into a slightly higher training skill-set such as tactile, specific body part presentations and manipulations, and crate and squeeze chute training. Since most tier two behaviors require more skilled shaping and building on tier one behaviors, keepers that wish to submit a training plan must have successfully trained and generalized a minimum of five tier one behaviors, working with at least three different individuals and two different species, and passed level one skill assessment and exam. Tier three behaviors are medical behaviors: injection, free-catch urinate, tail present, blood collection, ultrasound, and radiograph. All tier three behaviors require two trainers to work on them, and both trainers must be at tier three training level. These behaviors are also coordinated, and when appropriate, shaped with the veterinary staff. Like transitioning from tier one to tier two, staff must have successfully trained and generalized a minimum of five tier two behaviors with at least three different species, passed level two skill assessment and exam, before submitting request for approval to work on tier three behaviors.

Safety and communication facilitate one another and are paramount to a great training program. The unit's established behavior check-out and generalization to other trainers processes are a great example of both. Our zoo uses SharePoint for digital storage, and the unit keeps a folder specifically for training. This allows everyone to access all training documents. We used Microsoft Excel to create our main training database and it is there that we track the established behaviors and generalized behaviors. Once a primary trainer has trained a behavior to the desired criteria it is checked out as established by the zoological manager using the following criteria: animal completes behavior at

multiple times of day, animal completes behavior with at least two people observing, animal completes behavior in multiple locations, and an active safety check, in which the zoological manager evaluates all possible safety concerns with the behavior. These criteria must be met in two different training sessions observed by the zoological manager prior to the behavior being deemed established. Once this is completed the primary trainer should generalize the behavior to secondary trainers approved to work with the animal.

Our focus on clear communication extends into our documentation methods utilized as individual trainers. Trainers are encouraged, but not required to keep personal training logs. The logs can be as detailed as the trainer desires, and they are all stored on a shared platform so others can access them. The minimum documentation required for each training session is a ZIMS entry. Trainers enter a training note for each session performed along with a rating of the session. There are note templates used that convey when a new behavior has started, a regular training session whether shaping a new behavior or working an established behavior, and an emergency recall training session. We created two different rating scales for training sessions, one for shaping a behavior and one for established behaviors as the parameters of success are different for each. Using these scales we are able to clearly communicate our interpretation of how a training session went. The unit also keeps a training log of acclimation or training sessions that occur with veterinary staff present. Carnivore unit staff has the opportunity twice a month to invite veterinary staff to training or acclimation sessions with animals, and this also provides an avenue for communication between what veterinary staff would like a behavior to look like and what trainers are currently working on.

As a unit we communicate about our training program and plans not only at unit meetings, but also at twice monthly behavioral husbandry meetings. Meetings are on a rotating schedule to accommodate all staff to be present for at least one meeting per month. The focus of behavioral

husbandry meetings is to discuss and develop our training and enrichment programs. Open dialogue, brainstorming, and resource discussions are key components to these meetings. Through these meetings we are able to reach several of our program goals such as teamwork and staff development. In addition to communication strategies within the unit, the Saint Louis Zoo Animal Training Forum provides an outlet and resource for all areas of the zoo. It is an amalgamation of at least one representative keeper from each animal unit, along with representatives from the veterinary and nutritional staff, and a curatorial chair. Meetings are held monthly with varying topics of discussion along with evaluating training issues brought to the meetings and site visits to see training in action. The ATF also provides all zoo staff with an "Animal Training Basics" course and supplies a professional development grant for training related initiatives.

Maintaining and constantly evolving the carnivore unit training program is necessary for the best function, safety practices, and welfare of the animals. There is an appointed training coordinator that oversees and manages the training program. Some of the responsibilities of the training coordinator are to foster an encouraging and positive environment in the unit for training discussion, problem solving, learning, and exploring new ideas, promote and coordinate unit participation in the zoo's institutional training goals, and to attend monthly Animal Training Forum meetings and liaise between the forum and the unit to ensure active participation in zoo-wide and unit training programs. The coordinator also meets with the zoological manager and veterinary staff at least once a year to discuss and prioritize behaviors for all the animals in the unit. These priority behaviors typically stem from medical cases, an individual's history, or geriatric animal care significances. In order to collect an assessment of our training program from every member of the unit, the coordinator sends out the Managing Animal Enrichment and Training Programs questionnaire for completion by the end of the calendar year. Staff responses provide feedback on areas of the training program that may need clarification, revision, and what's going well or not well with the program. It then becomes the duty of

the coordinator to work with the unit to create satisfactory changes for the upcoming year's protocol. Through these methods the protocol can be under revision and improving throughout the year.

Starting a training program from scratch can be daunting. We found that setting a few important foundational goals, safety, welfare, and great communication helped us shape our protocols and policies. First focusing on all safety concerns working with carnivores shaped our proximity and feeding protocols. Next focusing on keeper safety and communication molded our training plan submission, behavior establishment, and behavior generalization plans. Evaluating animal welfare led our development of priority behaviors, training tiers and priorities, and increased our collaboration with veterinary staff. With application of our developed program we were able to find kinks that were worked out through clear communication in the unit. Having buy-in from all participants in the training program is important in developing an encouraging and respected training program. We have found our program still has kinks, such as time management for the check-out and generalization process, but we are working as a cohesive team to make our training program great for keepers and animals.

# Evaluating Enrichment: Looking at the Big Picture

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**Abstract**

Approximately three decades ago the Dallas Zoo established, documented, and implemented an enrichment program. After attending a Shape of Enrichment workshop in 2013 and learning about the S.P.I.D.E.R. framework, we began reviewing our program and realized that our next step was to evaluate the use of enrichment by individual species. We created an evaluation program to collect data on exhibit using focal animal scan sampling over a 21-month period on four different species of felids: ocelots (*Leopardus pardalis*), bobcat (*Lynx rufus*), cougars (*Puma concolor*), and tigers (*Panthera tigris sumatrae* and *Panthera tigris jacksoni*).

The evaluation program's focus was to assess enrichment interaction and usage on exhibit, as well as how the focal individual interacted with its exhibit as a whole. We also compared these behaviors to independent variables such as weather and crowd size. We showed that natural behaviors increased in an enriched environment, while focal visibility and stereotypic behaviors did not change in the enriched environments. This information allowed us to focus our program on two identifiable husbandry and welfare goals: decreasing stereotypic behaviors and increasing focal visibility while still providing a complex environment where natural behaviors could be expressed.

**Introduction**

Enrichment is defined by the Association of Zoos & Aquariums (AZA) as "a process to ensure that the behavioral and physical needs of an animal are being met by providing opportunities for species-appropriate behaviors and choices" (AZA 2018). For a zookeeper, enrichment is a key component in daily husbandry duties. However, finding a balance between effective enrichment and other daily husbandry duties can be a difficult task.

In 2013, Omaha's Henry Doorly Zoo and Aquarium hosted a Shape of Enrichment workshop, providing an amazing opportunity to learn more about enrichment and improve an already thriving enrichment program. The Dallas Zoo had an active enrichment program across various of species for approximately three decades at this point and we wanted to learn more.

Throughout the workshop, Valerie Hare (Shape of Enrichment) and other instructors presented numerous lectures and hands-on workshops on varying topics from starting programs to improving them, including what the next step should be in an active program. They even included information about the necessity of a written enrichment program that promotes species-appropriate behavioral opportunities as required by the AZA (AZA 2018).

At this workshop, the S.P.I.D.E.R. framework was introduced. This framework, first documented by Marty Sevenich MacPhee and Jill Mellen in 1999, gave a "more holistic approach to the enrichment of animals in captive environments and describes a framework or process that will ensure a consistent and self-sustaining enrichment program" (Mellen 2001). There are six steps to the framework which can be

found in Table 1. The framework has been used for almost two decades to develop and maintain successful environmental enrichment programs (Mellen 2001). The framework not only helps set up a purpose driven program but emphasizes the importance of change and improvement to an already existing enrichment program.

| **Table 1:** *S.P.I.D.E.R. Framework.* A process that will ensure a consistent and self-sustaining enrichment program (Mellen 2001). | | |
|---|---|---|
| Step 1 | Set Goals | What do we want this enrichment to achieve? |
| Step 2 | Planning/Approval | Which initiatives should be implemented? Who should review/approve? How will enrichment be provided? |
| Step 3 | Implementation | Apply and use approved items. |
| Step 4 | Documentation | What happened? |
| Step 5 | Evaluation | Did it achieve our goals? |
| Step 6 | Re-adjustment | Adjust the plan and start over with modifications to the original goal. |

After learning about the S.P.I.D.E.R. framework, we began comparing the enrichment program at the Dallas Zoo to the different steps of the framework. We had generalized goals (step 1) and were planning (step 2) and implementing (step 3) enrichment calendars as well as, documenting these uses (step 4). We even had an evaluation form (step 5) to measure how effective the items being presented to the animals were being used. The only problem was that keepers did not have the time to watch their animals all day to determine if a particular enrichment item was successful or not. We had no way to re-adjust (step 6) any issues because we didn't have enough information about how enrichment items were or were not being used. If we wanted our program to continue to improve and move forward, keeping up with ever-changing AZA policies, we needed to find a better way to evaluate the enrichment that we were currently using.

We needed a way to evaluate enrichment that did not take away from daily husbandry duties but would give us feedback on what we were doing right and wrong with our enrichment program as a whole. We knew that we couldn't ask keepers to stop what they were doing and simply watch their animals, possibly leaving numerous husbandry task uncompleted. So, we asked if anyone from our thriving volunteer department would like to watch animals and collect data. We got a great response from our volunteer department and the evaluation program was born.

We predicted that having enrichment present in an animal's exhibit would increase the animal's visibility and natural behaviors while reducing any stereotypic behaviors being seen.

**Method**

The species that we originally focused on were ocelots (*Leopardus pardalis*), bobcat (*Lynx rufus*), cougars (*Puma concolor*), and tigers (*Panthera tigris sumatrae* and *Panthera tigris jacksoni*). As more volunteers joined the program the species list increased and we began to make predictions of what our evaluation program data would reveal.

The evaluation program was performed at the Dallas Zoo over a 21-month period spanning November 2013 to August 2015 using focal animal scan sampling. Our original focus was on four felid species: ocelots, bobcat, cougars, and tigers. A map of each exhibit was made with a grid to identify the focal

individual's location. This map included both elevated and ground level locations. The zones were made based on permanent landmarks within the exhibits as well as taking into account historical information of where individuals spent the predominant amount of their time; therefore, each zone of the map was not the same size. An example of an exhibit map can be found in Appendix A.

The observations were completed by 16 volunteers and two interns. We also had six data entry volunteers. Each observer went through approximately three hours of guided training and 7-to-10 hours of individual training prior to being reliability tested.

Approximately 326 hours of data were collected by our trained observers, throughout the entire program. Of that data 70.25 hours of data were collected on the four felid species previously mentioned, making them some of our most observed species of the study.

**Table 2:** *Observation Hours.* A breakdown of the 70.25 hours of data collected on the four felid species.

| Species | Hours |
|---|---|
| Ocelots | 28.75 |
| Bobcat | 9 |
| Cougars | 22 |
| Tigers | 10.25 |

The observers recorded 12 independent variables at the start of each observation period. Each observation period lasted 15 minutes, with data collected every 60-seconds. At each instance five dependent variables were recorded: location, behavior, item, proximity, and keeper presence. An animal's location was determined by what map zone the animal's head was located in and whether or not it was on ground level or elevated. The behaviors recorded were listed on the ethogram in order of importance; therefore, if the focal was involved in more than one behavior at a time, the higher ranked behavior would be given priority. All of these variables, both independent and dependent, with their definitions and the behavior ethogram can be found in Appendix B.

The only time that the item variable was included was when the behaviors marking, play, explore forage or eat drink ruminate were recorded. Otherwise, this was an insignificant data point. We also required observers to notate whether a keeper was present, interacting with the focal or not present.

During data entry, a simple temperature range was created to assist us in reading the data. This temperature range helped to reduce temperature variables to one of four options.

**Table 3:** *Temperature Ranges.* All temperatures are in ° Fahrenheit.

| Term | Range |
|---|---|
| Cold | < 45° |
| Cool | 45° - 60° |
| Pleasant | 61° - 75° |
| Hot | > 75° |

The type of enrichment provided to animals was not altered in any way for the purposes of this study. The Dallas Zoo has a policy of only providing natural enrichment on exhibit. Enrichment items can be made from plastic if they are a natural color such as green, adobe, or brown and approved by area supervisors. Enrichment items can also be natural materials such as bamboo, sisal rope, or lumber presented in an unnatural form. Some enrichment items, such as olfactory or auditory, are not visible at all. Due to this variability, not all enrichment that is placed on exhibit is recognized as such by volunteer observers. For this reason, we had keeper staff maintain records of enrichment items that were offered and whether they were on exhibit or in holding areas.

We collected data to evaluate enrichment interaction and usage on exhibit, as well as how the focal individual interacted with its exhibit as a whole. Observations were not done when temperatures were <40°F as the majority of species being observed would not have access to their exhibits at these temperatures.

**Results**

For all felids, overall enrichment was present on exhibit 48% and absent 52% of observations. However, these numbers varied when looking at the focal species individually and not just for enrichment presence but also for visibility, natural behaviors and stereotypic behaviors. For this reason results are reported by focal species instead of the four felids species together.

*Ocelots*

Enrichment was present 87% and absent 13% of observations. When enrichment was present the ocelots were visible 77%, displaying natural behaviors 93%, and stereotypic behaviors 7%. When enrichment was absent the ocelots were visible 81%, displaying natural behaviors 100%, and no stereotypic behaviors.

*Bobcat*

Enrichment was present 41% and absent 59% of observations. When enrichment was present the bobcat was visible 86%, displaying natural behaviors 100%, and no stereotypic behaviors. When enrichment was absent the bobcat was visible 73%, displaying natural behaviors 99%, and stereotypic behaviors 1%.

*Cougars*

Enrichment was present 87% and absent 13% of observations. When enrichment was present the cougars were visible 89%, displaying natural behaviors 99%, and stereotypic behaviors 1%. When enrichment was absent the cougars were visible 100%, displaying natural behaviors 100%, and no stereotypic behaviors.

*Tigers*

Enrichment was present 94% and absent 6% of observations. When enrichment was present the tigers were visible 83%, displaying natural behaviors 72%, and stereotypic behaviors 28%. When enrichment was absent the tigers were visible 96%, displaying natural behaviors 40%, and stereotypic behaviors 60%.

**Discussion**

When we look at the data collected by our volunteers as a whole, encompassing all four-felid species, we almost get a completely different picture than reviewing it on an individual species level. Looking at all four felids, it appears that enrichment is only offered roughly 50% of the time on exhibit. However, once we review the data on a species level the only species this is consistent with is the bobcat. The ocelots, cougars, and tigers all had enrichment present at least 87% of observations. Considering these differences in results, it becomes incredibly difficult to report any findings bases on the four-felid species as a whole. Therefore, as with the results, we will discuss the data on an individual species level.

*Ocelots*

The ocelots were our most observed felid at 28.75 hours. They were a breeding pair that were housed separately except for periods of estrus. The female did have two fewer observation periods than the male due to impending birth of a kitten; otherwise, the two were observed consecutively with a random rotation of which animal was observed first.

The natural behavior of an ocelot during the day is to rest in a shaded, hidden area, changing locations occasionally. Therefore, resting in an area that is not visible or difficult to identify is a completely natural behavior. By providing resting locations that allow the ocelots to feel secure and hidden but still visible by zoo guests, the 33% of time they are not visible could be greatly reduced. This could also be accomplished with physical enrichment devices that can be manipulated to create line-of-sight barriers but not cover the entire animal.

If we look at what specific behaviors the ocelots were engaging in during this visible time period, more than two-thirds was inactive with the other third being divided between locomotion, self-maintenance and stereotypic behaviors.

When we just focus on the percentages extrapolated from the data, one could misinterpret it to say that having enrichment present with the ocelots resulted in an increase in stereotypic behaviors by 7%. This is a very misleading piece of information. A new evaluation with equal amounts of observations performed with and without enrichment present would be necessary to determine the validity of this hypothesis. We did, however, get an excellent set of baseline data on what stereotypic behaviors are being performed and by whom. In the case of the ocelots, the male was observed pacing 6.5% of the time regardless of the presence of keepers, while the female was observed pacing 0.5% of the time and all occurrences were when a keeper was present on the route.

Taking presence of a keeper into account, we looked at the location of the female ocelot when she was displaying stereotypic behaviors. All of this particular behavior occurred in front of the shift door. The observer did notate that the female ocelot was shifted into her holding area through said shift door, but this occurred after her observation period was completed. Knowing this information could help us to understand that the female may not stereotypically pace throughout the day but only in anticipation of shifting from exhibit. An inquiry from the keeper staff about the behavior of the ocelots prior to shifting each day would answer that question; then the stereotypic behavior could be altered through training.

Since the female's stereotypic behavior was explained by looking at her location while displaying this behavior, we took the same approach with the male ocelot and looked at his location when he was displaying stereotypic behavior. He used all four zones of his exhibit while pacing, staying on the ground at all times. Whenever he paced, there was enrichment present and he was observed pacing in the same

zone in which enrichment was located. Multiple types of enrichment were present when he paced including manipulata, olfactory, dietary, or a combination of the aforementioned; from this we know that a particular type of enrichment was not the causality of his pacing nor was it preventing it. Other factors that could have played a role in his pacing behavior could have been a number of variables such as weather or crowd size; however, none appeared to be a contributing factor.

In order to determine the cause of his pacing, we would need to collect more information. Knowing if he is pacing at the same time of day, the same length of time, and the behavior being displayed just prior to pacing occur would be vital in determining a way to reduce and or eliminate this behavior. If we knew this information we could possibly develop a training plan, altered feeding schedule or use holistic enrichment scheduling to deter this undesirable behavior.

*Bobcat*

The bobcat was our least observed felid at only nine hours; this still encompassed 36 separate observations. He was the only animal that the presence and absence of enrichment was closest to 50%. Therefore, I believe that it is safe to conclude that the presence of enrichment for the bobcat did in fact improve visibility and natural behaviors while reducing the occurrence of stereotypic behaviors.

Our observers did notate that the more often they did observations, the easier it became to locate the bobcat on exhibit. This may be due to the fact that observers became aware of the bobcat's preference in day time resting locations and, therefore, could more easily locate him. The observers made multiple comments that they frequently helped guests locate the bobcat during their observations. One way to improve visibility for the bobcat may be to add additional signage to the exhibit helping guests to identify his preferred resting locations, as well as educate guests on the natural behaviors of bobcats.

*Cougars*

The cougars were our second most observed of the four felids at 22 hours. They are the only species of felid at the Dallas Zoo other than lions (*Panther leo)* that are exhibited together as opposed to solitary as their natural behavior would suggest. They were both wild caught, nuisance animals that were castrated and approximately four years old at the time of the evaluation program. They have been exhibited together at the Zoo since their arrival in 2010 with little to no issues or separation.

There was an 11% reduction in the cougars' visibility when enrichment was present on exhibit. None of the enrichment provided allowed the cougars to be concealed from view and no other variables were consistent during this time period to conclude that they were the cause of this change either. It is to be noted however, that during approximately one third of the observations where the cougars were not visible, they were given access to their dens in preparation for their annual exams. This does not account for the other two-thirds of that time period where the cougars were not visible.

Like with the ocelots, when we just focus on the percentages extrapolated from the data, one could misinterpret it to say that having enrichment present with the cougars resulted in an increase in stereotypic behaviors but only by 1%. When we break this 1% down into the actual instances recorded we find that one cougar displayed pacing four times while the other displayed it six times. With such low amounts of this behavior being displayed there was not enough information to determine if a particular enrichment item was the causing factor or if it was another variable. We believe that 1% is an

acceptable amount of an undesirable behavior and should not be a deciding factor in whether or not to determine if a particular piece of enrichment is successful or not.

Of the four-felid species, the cougars were the most active, not including stereotypic behaviors. One showed preference of locomotion around the exhibit, both on the ground and elevated, while the other was observed being social with his exhibit mate and displayed multiple sessions of self-maintenance. All of these would be considered natural behaviors.

*Tigers*

The tigers were observed for 10.5 hours. This included four separate individuals that were shifted on and off exhibit up to three times a day, with a possibility of three different cats visible throughout the day at different periods of time. At no time during the study was there ever more than one tiger on exhibit during a particular time period. Our volunteer observers had a very difficult time identifying each individual tiger and records were not stored, which would have allowed us to retroactively identify each individual. For this reason, we decided to evaluate the tigers as a whole as opposed to individually.

The tigers represent our most drastic change in behavior when enrichment was present and absent. I presume this is due to the fact that almost all observations were completed with enrichment present. We believe that it would be inaccurate to assume that the presence of enrichment alone was the causality of an increase in natural behaviors and decrease in stereotypic behaviors. This is not to say that enrichment had no effect on the behaviors of the tigers, just that it cannot be guaranteed by the evaluation program.

The visibility of the tigers is acceptable, with the knowledge of their natural behaviors being that they have a tendency to rest in areas that may make them difficult to be viewed by our observers. Another variable to take into account is the exhibit itself. Unlike the other felid exhibits we have already discussed, the tiger exhibit (Appendix A) has four separate viewing areas. An observer or guest may not be able to see the tiger from all of these viewing areas or if the tiger is on the move, may miss it completely as it moves around the exhibit. This, however, would be considered natural and not stereotypic behavior.

If enrichment presence and the exhibit itself were not contributing factors in the tigers' behavior, then what was? We did find that independent variables such as the availability of shade, average temperature, crowd size, time of day, and keeper interactions all had no effect on visibility or behavior either.

Prior to the beginning of the evaluation program we knew that the tigers frequented certain areas of the exhibit more than others, which is why we made our map zones accordingly. More than half of the time the tiger was visible was in the two zones closest to the shift door leading to off exhibit holding and the behavior displayed was pacing. The tiger was not observed pacing anywhere else on exhibit. The tiger was observed displaying all 11 behaviors from the behavior ethogram. If we group the visible behaviors as active and inactive, the tigers were active 65% of observation. Of that active behavior, more than two-thirds of it was stereotypic pacing.

According to Miller (2012), "having viewed a tiger pacing significantly decreases people's perception of the level of care animals receive at that facility. In addition, people's interest in supporting zoos decreased as a result of viewing this behavior." So, although our tigers are visible at least 83% of the

time, they display stereotypic pacing behaviors up to 60% of the time, which could be having a negative impact on Zoo guests and animal welfare. However, how to change this could involve more than just enrichment or training alone. Since the conclusion of this study, the tigers are no longer shifted throughout the day, but an individual tiger stays on exhibit all day. Also, two of the individuals have since passed away and been replaced with individuals recommended for breeding by AZA programs. The amount of time spent pacing at the shift gate may have changed and an additional study would be required see if this change has reduced stereotypic pacing behaviors. Preliminary data from an intern research project over the summer of 2018 shows that when tigers are given the choice to go between inside holding and the outdoor exhibit, they spend much less time pacing. Although, they then spend more time indoors and, therefore, are less visible to zoo guests.

After reviewing the data on an individual species level, we did still find that there were two interesting results to note about the four species as a whole. In terms of visibility, a guest has an 81% chance of viewing one of these felids when they visit the Dallas Zoo. That's a 4-in-5 chance of observing an ocelot, bobcat, cougar, or tiger, even when looking at independent variables such as weather, time of day, and activity that is occurring at the Zoo in general, or dependent variables such as enrichment present. Even though the chance of observing one of these four felids is high, there is a 7% chance that they would be displaying the stereotypic behavior of pacing.

**Conclusion**

Since the conclusion of the study, the ocelots, bocat, and cougars have been transferred to different institutions and their exhibits have been removed in accordance with the Dallas Zoo's facilities master plan. No additional study can be performed to determine if changes to the enrichment program made any effect on the behaviors of the individuals in the evaluation program.

The ability to view an animal on exhibit is of utmost importance. A lack of animal visibility may negatively impact a guest's general satisfaction with an exhibit or a zoo as a whole (Esson 2009, Kuhar 2009). As more research is completed in order to improve the overall welfare of animals in human care, ensuring that guests can view the animals as much as possible, while not compromising the animal's welfare, is a constant concern during the design and building process of exhibits. Once an exhibit is built, it may not be possible for it to be altered significantly to improve visibility of an animal. But through the use of enrichment and other types of husbandry, keepers may be able to encourage the animals to spend time in areas of the exhibit that allow them to be more easily viewed.

Although it may seem unnecessary, I took the time to define what natural behaviors actually are for felids. As expected, we found many generalizations that said that most felids are solitary, territorial, and nocturne-crepuscular, meaning most active at dusk, overnight, and dawn (Hunter 2011). I found only one major generalized difference between males and females, which stated the females may spend more than 80% of their lives either pregnant or accompanied by dependent young, but otherwise felids are solitary animals with the exception of male cheetahs (*Acinonyx jubatus*) and lions (Sunquist 2002).

Knowing that there would be no major differences in behaviors between solitarily exhibited male and female felids, we needed to look deeper into what natural behaviors occurred during the non-active period of the day when all observations were recorded. All four felid species spend the majority of this time sleeping and grooming but vary in resting location preferences and amount of movement. Ocelots and bobcats tend to rest in areas where they can hide from the outside world with more than one route

of escape. On the other hand cougars and tigers will rest in shaded, not necessarily concealed areas in rural, unpopulated areas. Tigers can often be seen resting in shallow slow-moving water during the hot season. Cougars and tigers tend to rest in the same general location throughout the entire day, while ocelots and bobcats will change their location every few hours. These minor differences in behavior are attributed to the fact that cougars and tigers are considered apex predators in their natural habitats versus ocelots and bobcats, although still predators, live in the same habitat as an apex predator, in this case the cougar (Sunquist 2002).

From this research we can conclude that both active and inactive behaviors are natural, since all of these felids species are nocturne-crepuscular. We can also conclude that resting in an area that makes the felid not visible to the observer is also natural. This makes stereotypic behaviors the only behavior that differentiates itself from natural behavior.

Stereotypic behavior can be defined as a repetitive, constant pattern of unnatural behavior with no obvious goal or function. These develop from frustration-related behaviors such as but not limited to intention movements, redirected movements, and/or displacement activities (Mason 2006). Some examples of stereotypic behaviors are excessive grooming or preening, pacing, and fence chewing or rubbing.

Moving forward, the Dallas Zoo's enrichment program is being used by keeper staff in an appropriate manner. Enrichment is provided to animals in an appropriate and timely manner that aligns with the Zoo's exhibit policies. Recommendations for the future of this program would be to change the manner in which enrichment calendars are written. As opposed to writing them with the individual piece of enrichment to be provided as the focus, enrichment provided to the animals should be chosen holistically. This approach would take into consideration an animal's natural history, individual history and its specific exhibit constraints (Mellen 2001). This holistic approach included five categories that are not mutually exclusive and require keeper staff to create daily goals for the enrichment items to achieve for each individual. These five categories are social, cognitive, physical, sensory, and food.

"Enrichment needs to be more than a Band-Aid on abnormal behavior or inactivity; it should be a concerted plan of action for captive management with measurable goals and results. Such an approach will require a shift in the philosophy of most zoological institutions." (Mellen 2001)

The goal of the evaluation program was not to prove that the Dallas Zoo's enrichment program was perfect; rather, it was to show us where and how to make improvements and ultimately provide the animals with the highest standards of care that we can possibly give them. Enrichment programs are not foolproof and they should be constantly evolving with regards to the needs of the animals in our care. We believe that the Dallas Zoo's program is on the appropriate path to exceed the standards set forth by the AZA community and after review of the evaluation program results, we are ready to readjust and begin the S.P.I.D.E.R. framework again.

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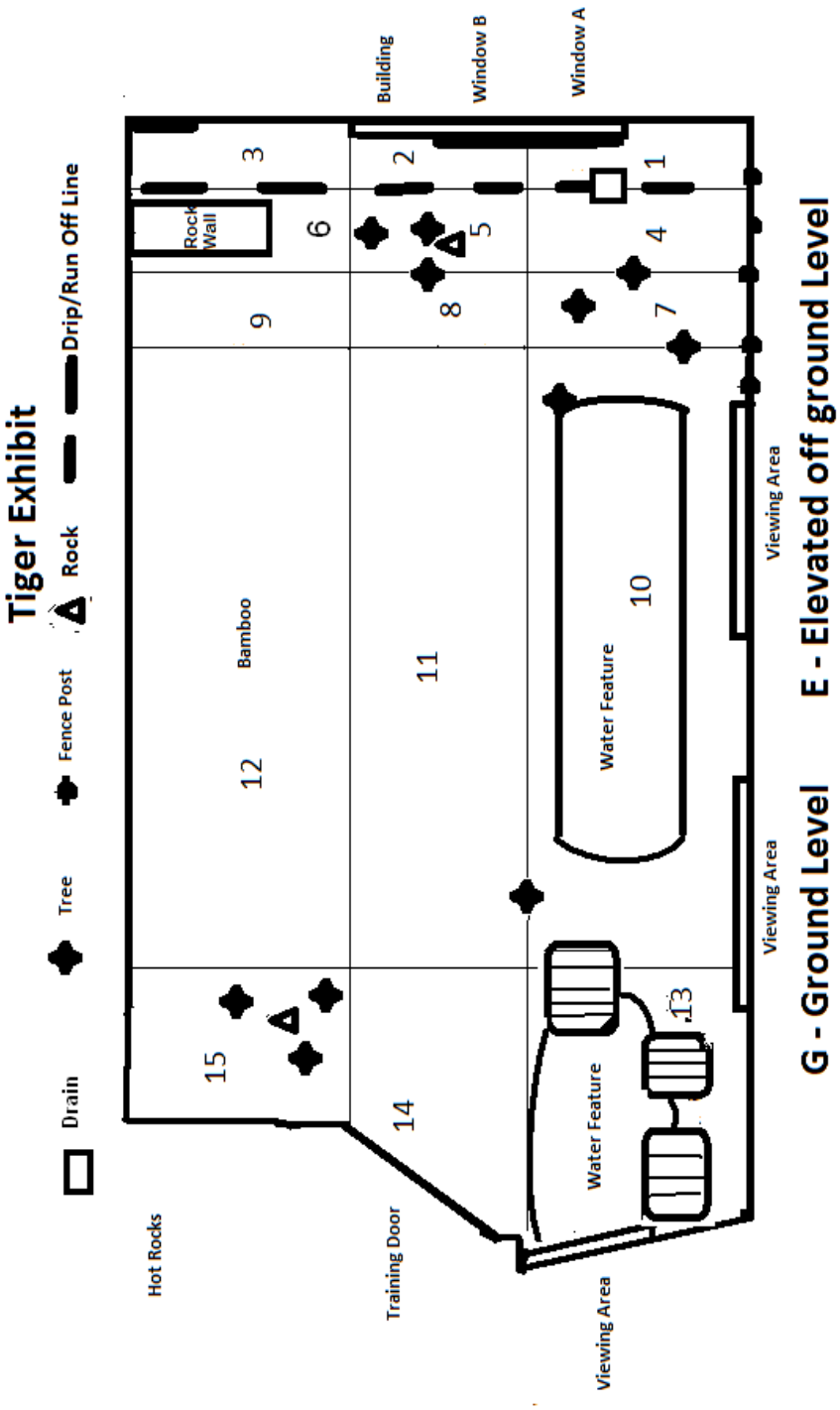
**Appendix A:** *Tiger Exhibit Map.* Map with varying sized zones used by observers throughout the evaluation program.



**Appendix B:** *Independent and Dependent Variables and Behavior Ethogram.* Variables and their definitions that were recorded by volunteer observers during the 15-minutes observation time periods.

- Independent Variables – variables recorded by volunteer observers prior to the start of the 15-minute observation period
    - Date – indicate the date of observation
    - Start Time – using 24-hr clock
    - Observer – first initial and last name
    - Species – kind of animal being observed
    - Focal – name of individual being observed or UNK
    - Others – other species or individuals in exhibit at time of observation
    - Weather – a range of conditions for the duration of the 15-minute observation
    - Crowds – a range of the crowd size for the duration of the 15-minute observation
    - Map Zone: Enrichment – indicate the numbered zones on the exhibit map items can be found
    - Map Zone: Food – indicate the numbered zones on the exhibit map food items can be found
    - Map Zone: Shade – indicate the numbered zones on the exhibit map that have more than 50% shade covering
    - Enrichment – describe what the item(s) are on exhibit; give item name if known
- Dependent Variables – variables recorded by volunteer observers every 60-seconds for a period of 15-minutes
    - Location – zone number in which the focal individuals head is located and whether the individual was **E**levated or on the **G**round
    - Behavior – 1 of 11 behaviors
    - Item – indicates the object the focal animal is interacting with for specific behaviors
    - Proximity – to the enrichment location or feeding station; always relevant to the animal's head/front end and body size
    - Keeper – indicate presence and interaction
- Behavior Ethogram – behaviors scored at the start of each 60-second interval listed in order of priority
    - **SO**cial – any active, directed aggressive/agnostic, affiliative/friendly, sexual, or parental behavior given from or received by the focal animal
    - **M**ar**K**ing – active scent marking
    - **Pl**ay – nonsocial frolicking
    - **E**xplore **F**orage – investigate or manipulate environment, object or food item
    - **E**at **D**rink Ruminate – consume/eat/ingest food or drink water; includes ruminating
    - **LO**comotion – traveling in space from point A to point B
    - **S**elf-**M**aintenance – auto-groom/lick, dust-bathe, scratch, etc
    - **ST**ereotypic – aberrant or stereotypic behavior; repetitive behavior with no apparent function
    - **O**ther Non-social **B**ehavior – behavior no described above with additional description written in the note section
    - **IN**active – focal is stationary and not doing any of the above behaviors
    - **N**ot **V**isible – cannot see the focal to record behavior; does not pertain to location

*Reptiles & Guests: Creating Positive, Defining Interactions*

1. All behavior has function, and using that knowledge, we can train an animal new behaviors using positive reinforcement. This training helps connect our guests with reptiles in several ways, one of which are defining moments. Each animal presents different obstacles, and opportunities, in creating these moments, and the unique behaviors of reptiles can allow for many opportunities to connect guests with them.
    a. Why is it important to create defining moments and what are they?
    b. Using positive reinforcement training to create defining moments accomplishes several things.
    c. Reptiles are forming lasting connections with our guests through basic behaviors and through interactions with their enrichment.
2. Why is it important to create defining moments and what are they?
    a. Defining moments are opportunities that we use to give guests a special moment with our animals.
        i. This can lead to conservation steps, create a new fondness for animals, helps guests feel a stronger connection to the natural world.
        ii. Turning fear and misunderstanding into appreciation and tolerance is essential to the conservation of reptiles.
3. Using positive reinforcement training to create defining moments accomplishes several things.
        i. It gives our animals control over their interactions with our guests.
        ii. It creates cooler and more memorable moments with those animals.

iii. It helps people think about reptiles as intelligent and understandable creatures.

4. Reptiles are forming lasting connections with our guests through basic behaviors and through interactions with their enrichment.

    i. Target training

        1. Approximations taken to train this behavior: introduce target and reinforce for acknowledgment (look or move towards), introduce target and reinforce for movement towards, introduce target and animal touches target with nose.

        2. Animals trained on this behavior: Bearded Dragons, Box Turtles, Red eared sliders, Glass lizard

        3. We use this behavior while feeding our reptiles with our guests. Small kids can hold the target stick, older kids/adults can feed or do the whole behavior on their own.

    ii. Chameleon

        1. Approximations used to train chameleon to step on Keeper's hand and allow guests to hand feed her insects: Bait chameleon to come to front of exhibit for feedings. Introduce hand for step up (baited) present hand and fade bait, cue chameleon to come out of exhibit onto hand for cricket reinforcement.

            a. Guests can now feed the chameleon by hand while she is out of her exhibit.

            b. She makes connections with guests through this small experience

            c. Helping overcome fears of reptiles (and insects!)

2. Guests learn some fun chameleon facts and connect them with other animals around the zoo.

iii. Snakes

1. We used to have docents hold snakes for guests to touch them but have moved away from that and instead we give the snakes a “Plinko” board for enrichment.
    a. Docents interpret natural snake behavior
    b. Gives our snakes exercise and makes it more their choice to be out of their exhibits.
    c. Allows us to get out less “handle-able” snakes for enrichment and increases their abilities to be animal ambassadors.

5. Using positive reinforcement training is beneficial to the husbandry and mental empowerment of our animals. It is also a really amazing tool we can use to change the guest perception of zoos, and also in this case of reptiles. The memories made from connecting guests with animals in these brief interactions can have lasting impacts, and they can help our guests feel like they have a connection with the natural world. Working with reptiles poses some interesting training obstacles from sporadic sessions and low seasonal motivation to higher awareness of antecedent arrangements. The reptiles are able to use this training to define a moment in time for our guests and hopefully inspire action from guests for better conservation steps and more understanding of them as living creatures that have the mental capability to learn and become great ambassadors for their wild counterparts.

*Lighting the Fire: Using Short Encounters to Inspire Action and Ignite Passion*

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## Abstract

Every animal care professional can likely tell you the exact moment or encounter which sparked their desire to work with animals and better the world for wildlife. As keepers, the opportunity to provide such an experience exists in virtually every interaction between ourselves and visitors. Through small changes in our daily husbandry routines or scheduled presentations we can foster a connection between our guests and our animals, and that connection can ripple into meaningful action. This paper aims to outline methods and ideas designed to bring people closer to the animals in our care with minimal effort or change. To name a few, involving guests in enrichment, taking the extra few minutes to explain what you are doing in an exhibit, or simply introducing an animal by name to a casual observer has the potential to change attitudes and kickstart careers. Today's keeper is more than a caretaker - they are a teacher, scientist, and beacon of inspiration. Our industry implores you to elevate your interactions; the next great conservationist may visit your facility and you could provide the experience which ignites their passion.

## Introduction

I vividly remember the shape, size, and spot pattern of the giant head lowering itself towards me over the fence. My Zoo Camp group had twenty children in it, but I was the only one who volunteered to feed Nifty the giraffe a milkbone during our behind the scenes tour. My five-year-old self was intimidated but excited; giraffe had been my favorite animal for as long as I could remember. I was not about to pass up an opportunity to interact with one up-close. When Nifty's fifteen-inch-long tongue slid out of his mouth, gently grabbed the treat from my small hand, and reeled it back into his wheelbarrow-sized head I almost exploded with excitement. The encounter was twenty years ago and the memory of it still gives me goosebumps. I firmly believe it was the exact moment I decided to spend my career in animal care, and it was all thanks to a gentle giraffe, a well-designed camp, and an incredibly kind keeper.

Most, if not all, people working in animal care can offer a similar story to mine – a fantastic opportunity which cemented a desire to make a living working with animals in some capacity. In many cases, these opportunities were presented or facilitated by an animal care professional with a willingness and desire to share their world. The Cheyenne Mountain Zoo in Colorado Springs, Colorado insightfully labels these as "Defining Moments;" chances to bridge the gap between visitors and animals not given to everyone who walks through the turnstile. Jeff Swanagan, former President and CEO of the Columbus Zoo and Aquarium, unofficially made the zoo's motto "touch the heart to teach the mind," articulating the need to first connect with visitors in order to educate and inspire change. Though both principles are timeless, with the current status of our planet and its wildlife, they are particularly important now.

My current position as an Animal Programs Specialist requires me to be proficient in both public engagement and animal husbandry. At their crossroads is interaction; fostering a bond between zoo visitors and the animals I care for. In that vein, there has been an increase in the amount of interactive animal experiences regularly offered in zoos. Giraffe feeds, "feeding" aviaries, camel and pony rides, petting zoos, and countless similar experiences survive because they foster a direct connection between animals and zoo visitors. As keepers, we have the ability to find more opportunities to make that connection and kickstart that passion in our guests through small, meaningful interactions. The routine tasks we perform and the contact we have with animals are easily taken for granted. Challenge yourself, though, to see them through the eyes of our guests. Each task is the work of one of the most sought after careers in the country, each point of contact a potential once in a lifetime experience. With the ability to share that and cultivate care and understanding between our animals and our guests we should seize the opportunity as often as we can.

**The Many Hats of a Zookeeper**

While our primary directive as animal caretakers is maintaining the health and well-being of our charges through diet provision, healthy environments, and behavioral modification, we wear many, MANY, other hats. One of the most important roles ALL animal keepers play is that of an ambassador or interpreter – we are the voices of the animals for which we care.

With that, it is up to us to bridge the divide between our animals and the people who come to see them. Most zoo visitors come through our gates with entertainment as their top priority, but also view it as an expected opportunity for conservation education (Ballantyne & Packer 2016). Engaging signs and graphics are important, but they are not stand-ins for real, live animal keepers. Povey and Rios showed that guests viewing a clouded leopard in an interpretive setting (live animal with a live human interpreter present to convey information) stayed to view the animals longer, were more receptive to information, and left with a better feeling about the animals' health and welfare than visitors viewing the animals in a traditional exhibit-and-sign setting (2005). Therefore, the best way to win over a guest and ignite their passion is with a live human there to facilitate the formation of those bonds.

Zoo guests who have been positively reinforced with involvement and information have been given the tools to be a voice in favor of the amazing work we do. At social gatherings, in passing conversation, and online platforms, these people will have positive memories to reflect on and, likely, a greater respect and understanding for the importance of our facilities. While not everyone may be comfortable doing large-scale public interactions on a regular basis, there are plenty of ways for keepers to encourage interaction, foster affection, and inspire guests across all jobs and skill levels. What will stand out to zoo guests is neither the size nor the caliber of the experience, but rather the gesture of taking time out of your day to make them feel special and, in turn, more connected with wildlife.

**Lighting the Fire**

*Keeper Talks*

Traditional keeper talks involve an interpreter or keeper in front of an animal exhibit giving information about the animals on view. This format presents many opportunities to incorporate short, meaningful encounters with guests. In these settings, where dozens of people may be gathered, it is especially impactful to find ways to draw individuals out of a crowd and build a history with them.

- Introduce the animals in the exhibit by name
    - Guests are more likely to connect with "Jeff" the iguana than "an iguana"
- Use personal stories from working with the animals
- Highlight an animal or group's intelligence or problem-solving ability
- Increase interaction with the audience
    - "What would you name an [animal on exhibit]? Why that name?"
    - Draw similarities between activities visitors do and the ones animals do (social grooming, swimming, picky eater, etc.)
    - Solicit questions; before answering, ask the guests' name and repeat it as you answer
- Let them know what behaviors to watch for and any habits the animals may have that the guests can observe
    - Example: The pythons are usually most active on Thursdays when we feed
- Remember, visitors are "never wrong" – if they offer something unachievable or outlandish, gently nudge them towards the "right" answer or ask questions they will be able to correctly answer
    - A positive participatory experience will have a longer lasting effect

When possible, positively encourage animal activity before or during your keeper talk. Active animals are more engaging to zoo visitors and allow for a higher potential of educational opportunities (Collins et. al. 2016).

- Place enrichment in the exhibit before your talk
- Add enrichment to the exhibit during the talk
- Shift a new group of animals into the exhibit before the talk

In addition to encouraging activity, these actions also open more talking points. Why a certain enrichment was chosen, what is in the enrichment, the specific social dynamics of a group or a species, and other similar points can easily be discussed and explained in this setting.

*Training Demonstrations*

Animal training demonstrations take many forms. Some may be a single session with an individual, others may involve multiple animals. Wildlife shows utilizing conditioned behaviors also fall into this category. Some may have an interpreter talking while another staff member conducts the sessions, while others may involve a single person talking while training. Regardless of form, there are a variety ways to increase the connectedness between animals and visitors.

Note: safety should always be the first priority for both the trainer and the visitors.

- Explain what is going to happen before the session starts
    - An expectation of what to see or why it is being trained holds the guests' attention
    - Leave room for surprises: "I am going to ask her for a behavior that helps us examine her stomach"
        - When the animal suddenly launches onto its back legs, the audience is taken aback but knew something was coming
    - If and when things to go awry, there is an opportunity to talk about the animals' agency and individuality
        - Refused behavior is never the fault of the animal
- Allow guests to guide the session
    - "Which behavior should I ask for next?" – provide 2 or more options and have the selected behavior next in the session
    - "Which behavior should I begin with?"
    - "He can do a spin to the left and a spin to the right – which way should he go first?"
    - Thank them by name after the session
        - Offer a prize or something physical if possible
            - A feather from the bird you are training, small token from the gift shop, etc.
            - The Animal Programs Department at the Columbus Zoo uses themed pins and rubber bracelets for these: feeding a tortoise earns you a tortoise pin, hiding cheetah enrichment gets you a cheetah bracelet, etc.
- When possible, allow guests to participate in the session
    - Ask a visitor to call the animal over to start the session
    - Ask a visitor to hold the target
    - Ask a visitor to cue the behavior
    - Allow a visitor to bridge the behavior
    - Allow a visitor to reinforce the behavior
- A positive attitude and genuine desire for visitors to participate are extraordinarily beneficial, as is the notion of letting a behavior speak for itself
    - In stead of asking the audience for applause, express your own excitement at a finished behavior and let the applause come naturally and on behalf of the animal and the correct behavior

Instead of saying they watched an animal be trained, they can report that they were a part of the process. Playing an active role in the care of the animal may be the action which kickstarts the career of an audience member, inspires a love of wildlife, or at least positively changes the perception of how the animals are cared for.

*Regular Exhibit Maintenance or Changes*

The majority of husbandry and exhibit preparation at most facilities happens before guests have access to the zoo. However, during the day situations arise where an exhibit needs serviced or tended to during visitor hours. In some cases, a physical barrier may separate keepers from visitors during exhibit maintenance. In others, keepers may erect a "mental barrier" between themselves and visitors. The "keep your head down and get the work done" mentality can be effective but also alienating. When possible, involve visitors, even ones on the other side of glass or across a moat, in the tasks you are doing. Often, a simple explanation of the task being done can mean a lot to a guest. In particular, opportunities are plentiful in cases where the animals are still in the area which is being serviced. The simple act of watching a keeper have tactile or emotional interaction with an animal can be enough to make someone say *I want to do THAT when I grow up!* or *I never knew [that animal] was so amazing – I love them!*

- Explain tasks to onlookers
    - Talk about why you are cleaning the pool, the importance of examining poop daily, or the reason you need to buff the acrylic
- Answer questions asked of you
- If placing enrichment, ask a guest *where* to place it in the exhibit
    - At the Columbus Zoo and Aquarium, we have guests wait for as long as 15 minutes before animals are shifted out after directing keepers in where to hide enrichment for spotted hyenas
    - Provide simple choices: Left side of the yard or right? In the tree or on the ground?
    - How many sprays of scent should I place?
    - By asking for a "volunteer" to help hide enrichment, a vicarious experience is provided to the entire crowd
        - Though only one person is helping, the whole group instantly gains stake in the action – "one of their own" is assisting
- Introduce them to the animals on exhibit or the animals that are about to come out
    - Provide defining characteristics of individuals
    - Predict behavior they can watch for
    - After shifting the animal out, go to the public side and interact with guests

These activities, though seemingly small, instill a sense of value, involvement, and investment on the part of the guests by involving them in the process.

*Just Plain Walking Around*

As the adage goes, "*no, I'm not going to feed something*!" Though undeniably annoying at times, such comments are direct evidence of the fascination so many people have with the work animal keepers do. They anticipate activity and have a genuine interest in how you spend your day. Instead of rushing away or shutting them down, explain what you are on your way to do. Often a quick word or sentence is more than enough to scratch the itch presented.

If passing by an exhibit, let the present guests know the names of the animals visible at that time or point out a favorite hiding place or sunning spot. The insight possessed by the people who

spend day-in and day-out with the animals is coveted. Allowing guests a glimpse into our daily routines may be enough to make them care.

## Conclusion

Every day in animal care presents opportunities to have short, meaningful interactions with zoo visitors. These are not to be taken lightly; one small conversation, experience, interaction, or acknowledgment may be the spark that lights the fire in a visitor. As keepers, we will always have too many things to get done in a day and not enough time. Animal well-being and health is our top priority, but the obligation we have to the people who choose to spend their time in the places we work is almost as important. Providing a nice exhibit or a quality show for them to watch is the baseline. Our focus needs to shift to the next level of interaction: inspiring them to do more, care more, invest more, or aspire to our career in the future. The next generation of zoo keepers and wildlife heroes are walking through our gates every day. It falls squarely on our shoulders to connect them to the animals we care for and ignite their passion for wildlife.

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# Training Eye Care in a Protected Contact Setting

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## Introduction

Louisville Zoo's Glacier Run area exhibit currently manages 3.5 pinnipeds [3.3 California sea lions (*Zalophus californianus*), 0.1 harbor seal (*Phoca vitulina*), and 0.1 gray seal (*Halichoerus grypus*)], 0.1 polar bear (*Ursus maritimus*) and 1.2 grizzly bears (*Ursus arctos horribilis*). As part of the day to day management, staff trains husbandry behaviors to aid in assessing the animals' overall wellbeing. All bear behaviors are shaped and executed in a protected contact setting; the behaviors asked of the sea lions and seals are mostly performed in a free contact setting. For purposes of this paper, protected contact will refer to the animal being completely separated from the trainer by means of a secure mesh enclosure. The keeper and animal do not share the same space and there is a barrier between the animal and the keeper. All behaviors are asked through this protective mesh. Free contact, will refer to the trainer being in the same space as the animal being trained. The animal and keeper are in a shared space and the animal is unrestrained. This paper discusses using training behaviors as a means of administering medications directed toward providing better health care for the Zoo's pinniped and bear population.

## Background

Diseases of the eye in pinnipeds are a common occurrence in both the wild and in zoos. It also appears that these diseases can and will affect all age groups. As stated by Colitz & Saville et al., (2010) one study looked at pinnipeds during a six year time frame and found cataracts in "animals of all ages, including pups." The reasoning for these eye issues is still under debate, but there are some theories as to why eye disease is so prevalent in zoo pinnipeds. First, the longer the animals live, the more likely they are to develop some form of eye disease. In "captivity, many (sea lions) become visually impaired by their late teenage years due to cataracts and lens luxations". (Colitz et al, 2010). Environmental factors such as general overall water quality may also contribute to eye problems. Changes in salinity and any of the chemicals used to treat and stabilize the water pinnipeds live in can possibly affect eye health. For example, oxidants used to sterilize the water such as "chlorine or bromine may cause corneal damage" (Gage, 2008). Spikes in these oxidants or exposure to the byproducts formed when there is a "combination of organic materials with [the] oxidants added to purify the water may cause or contribute to pinniped eye disease." (Gage, 2008). Ozone is another oxidant that is a popular disinfectant used in marine mammal life support systems. Unfortunately, if any residual ozone enters the animal pools according to Gage (2008) "[the ozone] may cause eye discomfort or damage."

Water quality is not the only environmental factor thought to affect pinniped eye health. Colitz & Saville et al., (2010) suggest that eye issues have many causes including, but not limited to, "genetic predisposition, exposure to toxins, sharp or blunt trauma, exposure to UV light, or any combination of any of these." Currently, focus is being placed on UV light and its influence on pinniped health. Pinnipeds living in a zoo environment are often called out of their pool or asked to look up at trainers, and in doing so, are looking up at the sun. Pinnipeds in the wild do things a little differently; they primarily sleep on land and open their eyes to hunt and swim, never looking directly up at the sun. Sometimes, pinnipeds living in zoos have to live in a pool that contains a blueish or other light-colored reflective surface on it; instead of absorbing the sun's rays, the pool will reflect the light, further exposing the pinnipeds to more UV light. Colitz & Saville et al (2010) go on to theorize that "chronic exposure to UV

radiation could cause degradation of (the)…structures that adhere the lens, resulting in lens instability and eventual luxation." Further, ultraviolet light influences cataracts in both older and younger pinnipeds.

Since eye disease is a common occurrence, zoos housing pinnipeds are reevaluating these pinniped habitats in order to minimize eye irritation. For instance, facilities managers are painting pools to better mimic a natural environment with the hope of reducing UV light reflection. Also, life support systems are being monitored by water quality experts, while larger shade structures are being built over pinniped pools to help deflect as much UV light as possible. Even with the implementation of these measures, there are still animals with aliments that need to be monitored and or treated.

**Louisville Zoo's Pinniped Training Program**

Louisville Zoo's Glacier Run staff addresses eye issue concerns by incorporating an eye drop administration behavior as part of their training routine. Veterinary staff prescribe various eye medications for these animals for a variety of reasons, such as to manage diseases of the cornea and lens. However, some of the animals are trained to receive non-medicated eye drops, such as saline eye drops, to desensitize the animal to the procedure so that in the event that one of these diseases occur, the animal will already be conditioned to the behavior. Training and feeding of pinnipeds at the Zoo takes into account the trainer's skill set, animal personality and habitat exhibit layout when shaping a training program. Some animals require greater patience and/or innovative techniques. Likewise some trainers have differing skill set levels and sometimes the training space, depending on habitat size, may not be the safest situation for a trainer and a rambunctious male sea lion. With this in mind, an alternative to administering eye drops in a free contact setting was explored.

Three of the Louisville Zoo's pinnipeds are male California sea lions. One is a fully intact male, Kahula. Another, Bart has been vasectomized and the third, Triton has been neutered. Taking into account that males, especially intact ones, will respond to the female sea lions in the building, and show behavioral changes that could possibly affect the success of training, a safe and effective way to give the necessary eye medication was needed. After consideration, calling the sea lion over to a mesh barrier appeared to be the ideal set up. This practice began with Bart. His past enclosure was cumbersome and since he is a high-spirited sea lion, safety and comfort of both trainer and Bart were taken into account. Even though his behavior can be predicted for the most part, he had, and continues to have, days when he wants to do things his way! So for trainer and sea lion safety, he was trained to present his eyes at a mesh barrier to receive eye medication. His current habitat has been up graded, providing a more safe and trainable environment. Triton has not been trained to present his eye at a barrier to receive eye drops. He continues to be given his eye drop medication in a free contact setting. As of the writing of this paper, protected contact eye drop administration for Triton has not been considered because of his behavior. Triton is a laid back animal that does not display aggressive or territorial behaviors that are associated with intact, sexually mature male sea lions.

Kahula, a young rescued male California sea lion was a perfect candidate for the protected contact eye drop administration behavior. Based on intact male California sea lion breeding behavior, there is always a possibility Kahula will become aggressive and territorial towards other animals and trainers during breeding times. Therefore, to set Kahula and his trainers up to succeed in eye drop administration, he was selected for the protected contact eye drop administration behavior. He was already receiving eye drops in a free contact environment and doing well with it! He was diagnosed with keratitis and receives tacrolimus, an immunosuppressant drug to "diminish recurrence of active disease" (Colitz et al 2010).

Since Kahula was already conditioned to receiving eye drops, desensitization to the actual drops was not necessary. The first step in training him to receive eye drops in a protected contact setting was to get him to present his head close to the mesh so that the eye could be reached with the eye drops. To achieve this, an "ear" presentation behavior was shaped.

In a free contact setting, Kahula was trained to station in front of the trainer, facing the trainer. Next, he was conditioned to target on a short target pole or the trainer's fist. The trainer would shift their target slightly to the side to move Kahula's ear closer to the trainer. With the sea lion's head turned and his nose on target, the trainer would present their hand in a "C" and touch his ear saying "ear." Once Kahula was comfortable with having his ear touched, the target was removed; the trainer showed the "C" signal and when Kahula turned his head slightly in the correct direction, the trainer reinforced him. Each session, he was reinforced for turning just a little more until he reached the desired behavior of squaring his ear right next to the hand presenting the "C' signal. One "ear" presentation at a time was shaped to prevent confusion. Kahula's left ear presentation was trained first followed by the right ear because when he was facing the trainer, his left ear was across from the trainer's right hand; the trainer was right handed and it was more natural for the trainer to train the behaviors this way.

Once Kahula was solidly presenting both ears in the free contact setting, his training progressed to the protected contact mesh, which was approximately two inch by two inch. Kahula was already conditioned to come to the mesh to eagerly receive fish, so his training was able to proceed to shaping the presentation of his ears to the mesh.

The same approach was used for ear presentation at the mesh in the protected contact setting as it was in the free contact setting. Kahula was called to the mesh and fed some fish. The trainer then showed the "C" hand signal and reinforced when he turned his head the desired direction, reinforcing him with fish. This step didn't take long to complete! After a few sessions he was turning his head and presenting this ear in the appropriate direction.

Next, when Kahula would present his ear, the trainer would wait for him to lean into or toward the mesh and reinforced when this was done. When Kahula was comfortable with this step, the eye drop bottle was shown; the trainer would say "eye" and place a drop of solution though the mesh toward Kahula's eye. The trainer did not attempt to immediately instill medication into the eye itself, wanting to make sure Kahula was comfortable with the eye drop coming from the other side of the mesh. Once he was content with this, the trainer asked Kahula to present "ear," showed him the eye drop bottle, said "eye," then dribbled eye drop solution into his eye, after which he was jack potted! As with the free contact "ear" behavior, the left side was trained first followed by the right side.

**Expanding the Training Model**

Once the eye drop behavior was completed with Kahula, Glacier Run staff was inspired to expand this training technique to include the Zoo's grizzly and polar bears. Although currently there are no published references to common eye issues in bears like there is with pinnipeds, and since bears do live together at many zoos, there is always the possibility of a scuffle resulting in an injury. In addition, even though there is currently no documentation of eye issues in bears, this does not preclude the eventual need for an eye drop behavior for bears. Therefore, the decision was made to proactively train the eye drop administration behavior with the Zoo's bears. Once approval was given by both management and vet staff, eye drop administration training began. Since currently no actual eye medication is prescribed for Louisville Zoo bears, a saline based eye drop solution is used as the practice eye drop.

Training the bears to present their eyes at a mesh barrier was similar to the pinniped protected contact eye drop administration training. The bears already sit at the mesh to train, receive food, and offer an ear presentation. For an ear presentation, the bear is to turn its head either left or right depending on the direction requested by the trainer. Once the bear turns its head, the ear is pressed to the mesh. So, to get the bears to offer "eye" when asked, the trainer just needed to build on already established behaviors.

While sitting at the mesh, the trainer would first ask for an "ear" then point at the bear's eye. Any time the bear would lean in the direction of the pointed finger, the bear was reinforced. This continued until the eye was as close to the mesh as it could get and held steady. This was jack potted.

Unlike Kahula, the bears were not already desensitized to the feel of a drop of any kind falling on their face. Therefore, once the bear presented its eye when asked and held its head steady, the trainer placed a drop of solution from the bottle onto the face of the bear somewhere in the vicinity of the eye, but not directly into it. When it appeared the bear was comfortable with this, a drop was actually placed in the eye and the bear was immediately given a jack pot reinforcement! The eye drop training for bears was also completed one eye at a time.

**Conclusion**

The Louisville Zoo uses a training based husbandry program to provide optimal animal care. Sometimes this care is required by the current health of individuals. At other times, preventative actions in care may be the better method. It may be as simple as having "a tool in the tool box" to use if something comes up in the future that needs attention. No matter the reasoning for certain types of care, training a behavior will prove useful even if that behavior has to be modified to fit a situation. It is through the thought and creativity of the staff at the Louisville Zoo that similar behaviors can be trained and executed in different ways in order to fit a possible situation that provides the most optimum care.

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# Training Communication: The Art of a 3 Way Conversation

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**Abstract:**
For any training session to be successful there should be fluid two-way communication happening between the animal and the trainer. When the trainer is attentive to subtle behavior changes, they can perceive cues or signals, given by the animal to determine when to move forward with their approximations or when to take a step back. To further complicate the art and science of animal training, many husbandry behaviors require a second person to assist in the process. We've labeled this person as the mechanic. It is essential for the trainer and mechanic to clearly communicate their training plan and expectations to one another. This allows them to have a well thought out plan on how to react consistently to the cues and signals given by the animal throughout the session. When the trainer and mechanic have clear and fluid communication it allows the training process to move forward much more quickly. We'll discuss how to set up the antecedents of your training session to create consistent and successful communication between the trainer, mechanic, and animal.

**Introduction:**

When training any new behavior one should always have a final approximation of the behavior they are trying to train. When we think about the training process we should also think about how we want to set up our antecedents, how many people it will take to train this behavior, define the roles of everyone participating in the session, and how to communicate seamlessly throughout the session. While in the preparation process of training we should be looking for ways to allow the animal to freely communicate with the trainer and mechanic as well. A training session should not be viewed as a one way conversation but a fluid conversation between everyone involved. We will provide tools to overcome common training challenges like communicating with teammates, creating an understanding of overt animal behaviors, and how to use your environment to be a successful listener and in turn a great conversationalists while training.

**Preparation: Laying the Building Blocks for Successful Communication**

In order to have successful communication one must have a clear understanding of their goal behavior and the steps they plan to take to accomplish that behavior. To obtain this, a pre-training talk outlining approximations or steps of how the training session will progress is an important step. During this talk everyone should understand the smallest steps that one will take to progress forward or to take a step back if the animal is not ready for the next step. By openly talking about the training process it might yield multiple ways to train one behavior or different environmental cues that could be used to achieve greater success. But most importantly, it will provide a clearer understanding of the next steps in completing the behavior and allow a trainer to meet the animal where they are in the learning process.

Once we have determined what behavioral approximations we are going to reinforce, we need to have an understanding that every animal will learn differently and it is important to look at each individual animal as a "study of one". This means that every individual animal will progress differently and through different ways of learning which could lead to a roadblocks or challenges. Some training sessions won't

go according to plan and all involved must be flexible and able to adjust their communication in order to proactively avoid roadblocks. Combing the pre-training talk and understanding that every individual is a "study of one", will move you in the right direction of accomplishing the goal behavior.

**Trainer- Mechanic Communication: It's all About the Details**

Even with a well thought out pre-training talk and clear understanding of how to move forward in a training session, things can get more complex when assistance is needed from a second person, the mechanic. However, the assistance of a second person might be necessary for multiple reasons and figuring out how to most effectively and efficiently communicate before, during, and after the training process is a crucial component to having a successful training session.

We talk a lot about how important it is to maintain high trust accounts with our animal learners and it is just as important to do that with our fellow trainers as well. Sometimes we don't get to choose who our training partners are. When assigned a partner that you may not be that familiar with, there are a couple steps you can take to ensure that the two of you can build an effective working relationship to accomplish your training goals. Discussing how both of you prefer to receive feedback prior to giving it is a great way to be proactive. Both the trainer and mechanic should have a fluid and open dialogue during and outside of the session. Both participants need to be feel comfortable and empowered during the session. It should also be ok for both parties if at any point during the session they are getting frustrated or uncomfortable to immediately end the session and discuss how to move forward again in a successful manor. It is much easier to take a step away from the session, regroup and then figure out how to move forward than to try and push past it and let frustrations build. It is also important to have a shared language so we don't inadvertently affect the animal. Animals might pick up on a conflict between the trainer and mechanic by picking up subtle body language cues towards one another. This in turn might make the animal nervous or not want to participate in the session. Once open dialogue between both the trainer and mechanic is possible discussion can begin for expectations and approximations in the training session.

While figuring out how to communicate effectively with one another it is also important to define the role of the trainer and mechanic. One must discuss who will bridge, who will reinforce, who will be the one to move forward in the session verse taking a step back etc. During some sessions the mechanic might bridge while the trainer reinforcers while in other sessions the trainer might bridge and the mechanic might reinforce etc. These roles should be identified and set up before the session in order to be successful. After identifying the roles and creating a clear understanding of what our body language communicates to one another, such as a slight head nod to move forward or a shake of the head to repeat that step, it will help propel the session forward and decrease potential roadblocks. It's equally important that the mechanic provides feedback to the trainer on what they are currently doing during each repetition. The mechanic should also have a clear understand of what the bridge means to them. Is it a keep going signal, a repeat this step, keep your hand on, take your hand off, or let's take a step back to name a few. Having a plan to describe what our body language means to one another is important in decreasing frustrations and having an open and fluid dialogue. During the session we might not have time to fully explain what each person did, but having subtle cues that we understand can increase ones training proficiency. However, we need to talk about all of the subtle cues beforehand or one might miss this information and the session won't progress quickly. After both trainer and mechanic feel comfortable and have an understanding of what to look for from one another, it is now time to add in the third part of this equation.

**Listening to the Learner: Identifying "Tells" and Deciding How to Respond**

During any given interaction with an animal they are always communicating with us and responding to their environment. No behavior happens in a vortex, behavior is a product of one's environment and consequences that occur from behaving. However, there are antecedents that we can arrange before any training session to make us more successful. It is up to the trainer and mechanic to create the best learning environment possible and listen to every minute, overt behavior that is observable, which we have labeled that as a "tell". What is a "tell"? Think of a poker game. Every player is trying to hide their "tell" or signal from other players so they do not give their hand away and lose. These signals or "tells" can be very overt to almost covert if we do not pay close enough attention. In relation to training, one should be able to communicate with an animal when they are ready to move forward, when they need to take a step back or when something should change in their environment by using these behavioral signals which are an essential piece in fluid communication. Body language or these observable behaviors are easy to spot, however, the hardest part is that one does not always listen to that behavior.

How does one identify a tell and who has tells? As mentioned before, every animal and human should be viewed as a study of one. This means that every individual will respond to stimuli differently and thus one method of learning cannot be applied to every individual animal or person. Each individual has their own way of communicating and responding to their environment, thus every individual will have their own tells. We don't all fit into perfect boxes; we all learn and perform tasks slightly different from one another. The same can be said about training, every animal will learn differently but some general observations and conclusions can be made after collecting seen data that supports those observations. To further explain, if an animal consistently flinches every time a hand approaches them, it can be concluded that the animal is saying "No, I don't want to be touched there" or "I'm not that comfortable yet." The same example can be used with our teammates, if a person doesn't want to be touched they might move away or make a face etc. We are essentially identifying what overt behaviors make an animal or human "nervous" or "hesitant" and operationalizing them.

Why is listening to a subtle cue or "tell" so important? It provides the animal with more control and choice in their training and provides both the trainer and mechanic with more behavioral information. When an animal knows that the smallest subtle cue will be understood, then aggression and frustration can be decreased and a more resilient learners can be created. If the animal has more choice in their own learning they usually offer more behaviors or bigger behaviors in order to elicit a reinforcer. When one sees a tell in their training session there is one thing that should always happen, listen and revise your plan. One should not keep trying to same thing over and over if they are getting the same response or tell from the animal. The tells that get ignored will continue to get louder and louder until they are heard. However, the tells that get listened to will decrease and the animal will have learned that they have more choice and control over the session. Once the animal understands that they have control over the session by using small behavioral signals, we can freely open the dialogue between all parties in the training conservation. Thus allowing the process to move along much more quickly than taking away their voice and control in the training process.

With that information, the trainer and mechanic could do a multitude of different things but what if they missed that flinch or didn't recognize that as communication from the animal and tried again without changing how they approached their next step? Most likely, the behavior of flinching will increase or

further escalate. For example, think of someone doing the "I'm not touching you" and their finger is almost in your face and all you want them to do is to stop getting in your personal bubble. If they do not stop when you move away slightly, then the next time you will most likely say, "please stop." If they continue to move towards you or stay in that same spot you might ask again or you might yell at them to move away. If they don't move away after that you might then physically move their hand away with your own. At that point, you are most likely frustrated or upset with that person for not stopping when you moved away or listening to you when you asked nicely. To put this into animal terms, an animal should be able to tell us with the smallest amount of behavior that they are not ready to move forward at which point the trainer and mechanic should stop and reassess how to move forward. Becoming aware of those smaller covert behaviors will greatly increase the fluidity in communication between the trainer, mechanic, and animal.

By listening to smaller "tells", it will allow for an open dialogue between all 3 participants and the desired behavior should increase if the antecedent arrangement is right. What is an antecedent arrangement? It is when the environment is arranged in such a way that it will elicit a specific behavior. There are certain things in the environment which help cue or signal and provide more information about the behavior. For example, if one is training an animal to stand close to a barrier and the keepers needed to be protected contact and had to stand on the opposite side of the barrier, cones could be used to create a chute. The cones provide an environmental cue that tells the animal that if they stand between the cones and the barrier then they will get a reinforcer. The cones are a prompt which can be faded out quickly, but have already positioned the animal closer to the keeper and allow for much faster training. Compared to trying to free shape the behavior without any environmental cues.

**Post Session: The Antecedents of Tomorrow**

Where do we go from here? After the training session is finished there are a few last steps to complete; have a post training talk, problem solve or readjust your training plan if a roadblock popped up, and figure out what the next steps are. First things first, if you had success, celebrate it. Talk about what made that session successful and make sure that everyone is participating in the talk down. Everyone should be able to share in the successes and talk about what they thought went really well and what they think could change for the next session.

What if the session hit a roadblock? Talk about ways to problem solve and reassess the training session. Brainstorm other ways to collect information to get a better overall picture of how things went. It might be helpful to have an extra person watch and provide objective feedback or videotape the session and watch it right after and see if you missed anything or would do things differently in the future. If one can replay their training session, watch for missed behavioral signals, break down of communication between the trainer and mechanic or between the trainers and animal, or see how you can alter antecedents in the environment.

After collecting more information and receiving feedback it is now time to figure out what your next approximations are before the next session. This is an important step in perpetuating the cycle of setting the team up for success. While collecting information, there might be something that was overlooked but now identified. It is up to the trainer and team to assign any action items that need to happen before the next session. For example, do we need to bring down vet staff for desensitization, create a mock up of an x-ray plate, get new food reinforcers approved, or redesign your training space etc.

**Conclusion:**

Being attentive and creating an open dialogue between the trainer, mechanic, and animal, will allow the training session to move forward at a quick and efficient pace. Having previously agreed upon expectations as well as clearly defined roles before any training takes place will ensure trust accounts between all parties remain high. Creating this open dialogue of actively listening to body language will help guide any training session forward or provide information on how to readjust training steps based off of communication. Thus, giving the animals in our care the loudest voice possible and ultimately more control over their environment. By always listening for subtle cues from the animal, labeled as “tells” in this paper, the decisions on when to move forward and when to readjust the training plan become clear. Steps to ensure a flawless platform for three-way communication should be considered each time we begin planning a new behavior.

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# "Um, I'm done, thanks," Offering End of Session Choice

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**Abstract:**

A primary reinforcer is anything that occurs naturally and doesn't require learning or association to be inherently reinforcing. The ability to choose has been postulated to be a primary reinforcer because having a choice is an advantage to one's survival. Although animal trainers would like to believe their presence in a training session is in itself wildly reinforcing, it is more important for the trainer to read the animal's behaviors and ensure they are providing positive reinforcement opportunities such as choice.

In the case of a North American river otter (*Lontra canadensis*) at the Downtown Aquarium Denver, cues and signals including aggression, wandering, avoidance, and escape indicated that ending a session might be more reinforcing than the food associated with it. Trainers decided to place a visual marker in the area during sessions, and if the otter touched the shape, the session would end. After the introduction of the shape labeled "end of session," aggression, latency, wandering, avoidance, and escape were all reduced. The shape was even generalized to introductions with our male otter, so either otter could choose to end the introduction as well. Both creative options and the addition of choice are necessary to continue to evolve animal training.

**The problem:**

In 2016, the Downtown Aquarium acquired an eight week old orphaned North American river otter pup (*Lontra canadensis*). Olive was rescued in Florida by Owl's Nest Sanctuary who deemed her unreleasable because she was imprinted. She arrived at the Aquarium in March and received around the clock care from trainers and the curatorial team. Since she was imprinted she was identified as a suitable candidate for training as an animal ambassador and participated in meet and greets with the public.

During these meet and greets and other training sessions, Olive would perform a variety of behaviors (Image 1 and 2). Most of the time she voluntarily completed all of the behaviors without incident, but on occasion she would leave session, bite trainer's shoes, grab trainers' legs, and refuse to crate to end the session. Trainers grouped behaviors into three different categories: bites, precursors to aggression, and frustration behaviors (Table 1). Since aggression and frustration can be difficult to operationalize, the following were identified as behaviors that would be exhibited when Olive was more likely to aggress or if she was "frustrated". The frustration behaviors often occurred before pre-cursors or in response to requests for challenging behaviors.

A variety of solutions were attempted including decreasing the number of trainers, creating more variety in sessions to keep her interested, and offering a variety of reinforcement items. These changes weren't enough to keep her at session consistently and thus did not always seem to be reinforcing enough.

**The Identified Solution:**

Trainers started to wonder if ending the session could be more reinforcing than food. This hypothesis had been tested with a dolphin at Dolphin Quest (West, 2016). They gave their dolphin the option to choose a variety of reinforcers, one of which was ending the session. The dolphin could choose by selecting a certain shape placed near

his pool. Aggression towards guests and trainers decreased when given this option; while there was an initial burst of end of session (EOS) selection, over time aggression and EOS choice were nearly eliminated.

This is just one example supporting the concept that having control over the environment is in itself primarily reinforcing. If control allows an individual to ensure survival, and survival is a basic biological need, control fits the definition of a primary reinforcer (Harris, G. Susta, F., 2016)

Based on Olive's behavior we decided that in some cases being in control of session timing was potentially more reinforcing than food. Based on a continuation of the previously listed frustration behaviors, trainers created an option to allow Olive to end her own sessions.

**How Trainers Implemented the Solution:**

Trainers placed a square plastic shape in the area at every session (Image 3 and 4), either protected contact or free contact. The protocol is listed as follows:

1) Shape will be placed in the same position at every session.
2) If she touches the shape at any point during the session the session ends.
3) End the session as you normally would:
    i. Free contact outside of enclosure- crate her and reinforce her in crate
    ii. Free contact inside of enclosure- leave 3-5 pieces of food and exit enclosure
    iii. Protected contact- push 3-5 pieces of food under and step away

Initially it took some trial and error to make sure that all trainers remembered the shape and placed it in the area with her, but after a few weeks consistency improved.

**The Results:**

Olive touched the end of session (EOS) in each session for the first three sessions. It was hypothesized that many of the initial times EOS was selected, she was merely investigating the new object. The seventh time she selected EOS was after a few incorrect responses, which historically increased the likelihood of aggression and frustration behaviors. Trainers believed this was an intentional EOS choice. Over the course of the next year, most EOS selections occurred during sessions where a new behavior was being worked, when there were many distractions and competing reinforcers, and when Olive's food motivation was low.

Table 2 shows that for the year prior to implementing the EOS option trainers experienced an average of 4.3 bites per month, the year following implementation we experienced 0.2 bites per month (t-test $p=0.004$). Precursors to aggression also decreased from 3.4 precursors per month to 0.4 (t-test $p=0.012$). Behaviors that were identified as frustration behaviors went from 9.8 to 6.1 behaviors per month, however they did not change significantly (t-test $p=0.152$).

As shown in figure 1, selection of EOS spiked during the first month we introduced the shape; during this period she selected EOS 17 times. The second month she selected EOS 9 times. In the following months it decreased to an average of 2 times per month. The trainers believed that curiosity and novelty in the first couple of months contributed to the interest in selecting to end the session.

In addition, to decreasing aggression and frustration behaviors, the EOS option also contributed to successful otter introductions. Shortly after end of session was initially introduced, we started introductions with Olive and one of the male otters. We decided to leave the EOS in the reserve area so if Olive wanted the introduction to end, she

could select EOS. On the second introduction the male touched the shape. We closed the gate and separated the two otters. He caught on quickly and selected EOS to end every introduction after that. Our introductions were safe and successful and the otters were able to exercise some control over those encounters.

**Conclusion**

This case study demonstrates that offering your animals control over their environment has the potential to reduce aggression and frustration behaviors. It's important to read your animal's behavior so you can be sure that you're offering choice over things the animal finds reinforcing. We are in the process of brainstorming how we can offer these options to other species in our care and apply them to other situations.

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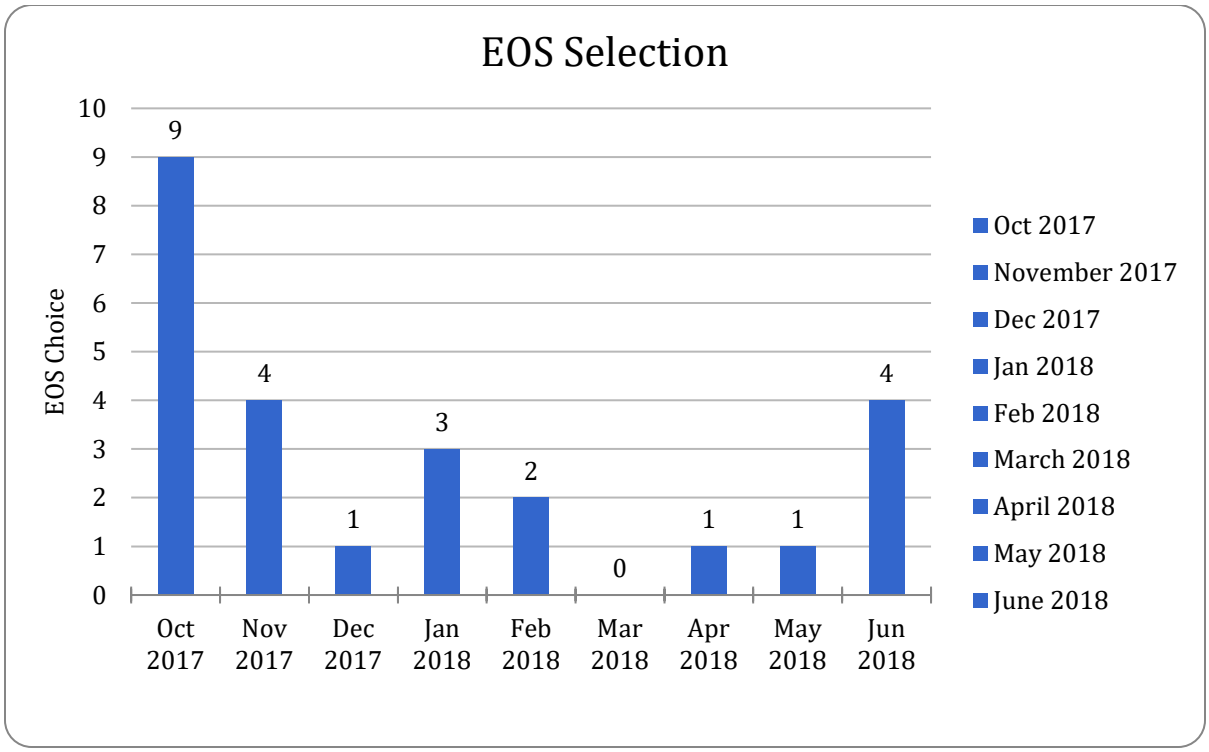
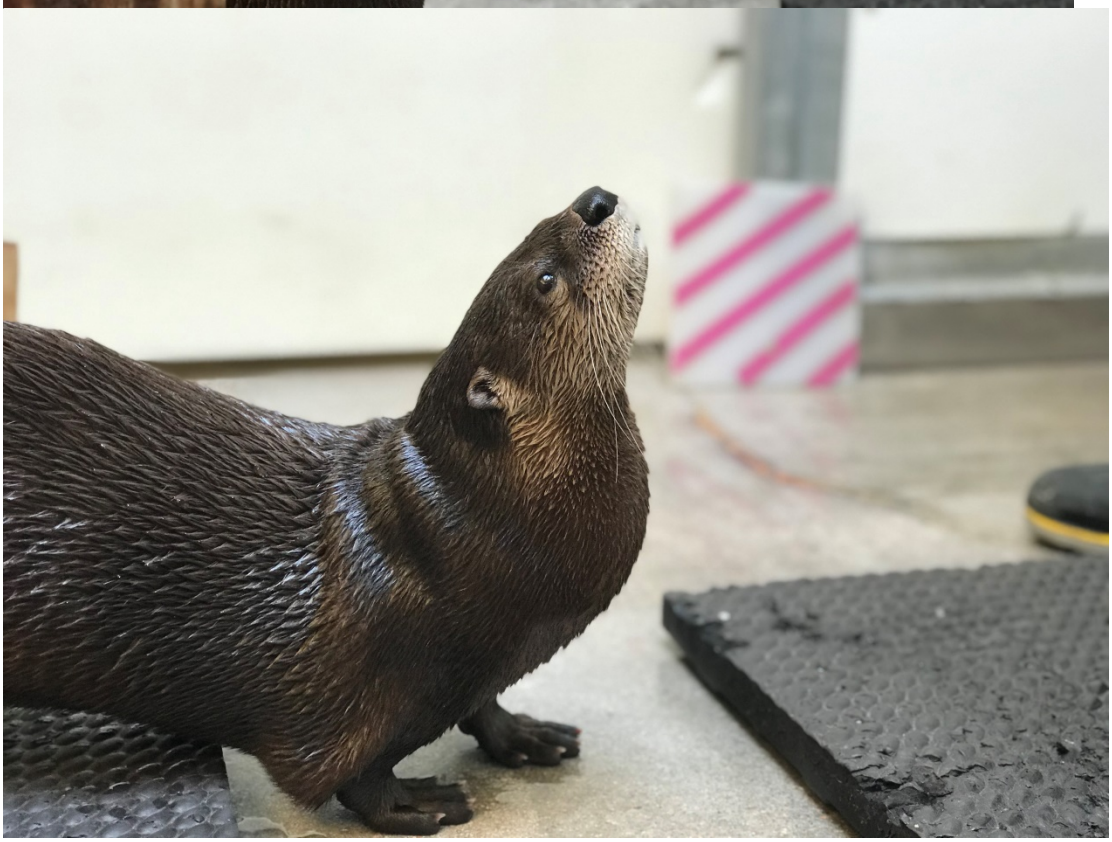


| Precursors to aggression | Frustration behaviors |
|---|---|
| Nibbling on trainer hands, shoes, or legs | Leaving session to swim |
| Grabbing legs or shoes with paws | Interacting with toys |
| Encroaching on the trainers space | Avoiding proximity to trainer |
| | Positioning body to inhibit requested behavior |
| | Wandering room |
| | Leaving stimulus control |

Table 1: Frustration and aggression bxs

| | Average number per month before EOS | Average number per month after EOS | T-test p value |
|---|---|---|---|
| Aggression | 4.35 | 0.20 | 0.004 |
| Precursor to aggression | 3.41 | 0.40 | 0.012 |
| Wandering | 9.82 | 6.10 | 0.152 |

Table 2: Frequency of behaviors prior to and after implementation of EOS



# Wake UP! Approaching Animal Care to Increase Activity and Visibility of three Sumatran Tigers

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## Introduction

Tigers are one of the most charismatic animals commonly on display in zoos and aquariums. Studies have shown that guests have much stronger connections to conservation when they see animals active and displaying natural behaviors (Powell and Bullock, 2014). Additionally, guests who are able to make eye contact with animals in a zoo setting are more likely to have an increase in conservation mindedness (Powell and Bullock, 2014). However, tigers are known to spend most of their time either inactive or patrolling their territory (Zhen-sheng, L., Feng, L., Li-wei, T., Xiao-yu, Z, 2002). Large cats are also fairly prone to exhibit stereotypical behaviors (also referred to as abnormal repetitive behaviors) in captivity, which tend to be viewed negatively by guests (Kroshko, Clubb, et al, 2016). Many different techniques have been used to increase more positively viewed behaviors, or "desirable behaviors", and to decrease "undesirable behaviors" such as stereotypical behaviors. A study by Rose, Riley, and Nash (2017) has suggested that some of the risk factors involved with these undesirable behaviors include small enclosure size, solitary living, predictable feeding times, visual access to other animals, and lack of access to a pool.

Previous research has looked at what types of husbandry have an effect on activity levels in animals in the care of zoos and aquariums. They have also studied how guests perceive animals based on their activity level. Environmental enrichment has been shown to increase activity in tigers (Skibiel, 2007) and to improve guest perception of animal well-being (Powell and Bullock, 2014). Different types of environmental enrichment have been tested against each other in an attempt to determine which is the most effective. Studies have mostly focused on hunting, feeding, and olfactory enrichment, which have been found to be successful (Szokalski et al., 2012). Social forms of enrichment have been tested far less, and studies have found varying results, perhaps due to differences in individuals. Studies have shown that large felids respond positively to having fewer relationships with human trainers, suggesting that the quality of the relationships are valued over the quantity (Wielebnowski, et al., 2002). Additionally, operant conditioning is suggested to be a type of enrichment that encourages animals to actively think and make decisions, as well as developing a bond with their human trainers (Clayton, 2011).

In 2016, the staff at the Downtown Aquarium was experiencing a breakdown in shifting behavior, with three Sumatran Tigers (Panthera tigris sumatrae), especially when attempting to shift them from the reserve area onto exhibit. Staff predicted that if the tigers had more positive associations with being in the exhibit space due to an increase in rewarding experiences, the shifting behavior would be strengthened. Additionally, if the reliability of this behavior could be increased, guest experience would also improve due to better visibility of the tigers.

The animal care staff at the Aquarium enacted a project specifically to address two issues: encouraging 3.0 Sumatran tigers to be more visible and active throughout the aquarium's open hours, thereby creating a better experience for guests, and increasing the reliability of their shifting onto exhibit from the reserve area.

## Methods

### *Participants and Study Site*

The Downtown Aquarium Denver is a dynamic aquarium located in downtown Denver, Colorado. Over 575,000 guests visit the Aquarium each year and are immersed in two river systems featuring animals found in those ecosystems both in and out of the water. A unique element of the Rainforests of the World ecosystem are three male Sumatran tigers, Jalan, Besar and Marah. All three Sumatran tigers came from the National Zoo in Washington D.C. and are now residents of the Aquarium. They are litter mates, and all are 13 years-old, born on the 2nd of May 2004. The Aquarium is accredited by the Association of Zoos and Aquariums and the tigers are part of the Species Survival Program.

### *Procedure*

The study was designed to evaluate what types of management might increase activity and decrease abnormal repetitive behaviors. Six independent variables were selected to test against the control. Three of these trials included varied feeding times, access to reserve area to increase space, and increased time with littermates. The other three variables were enrichment based: daily novel enrichment, animal ambassadors were walked near their exhibit space, and the occurrence of on-exhibit training sessions was increased.

The control period was split over two different months with one of the trials in between. Initially the plan was to do only one trial, access to reserve. After the first trial was complete, trials were added to test other variables to expand their understanding and knowledge of the tigers' preferences. During both control periods trainers followed a "normal" routine, meaning that enrichment, training sessions, shifting, and other variables included in the trial were kept at a minimum level.

The first independent variable, access to the reserve, involved allowing the tigers entry to both the exhibit and a portion of the reserve area. The tiger exhibit at the Aquarium has a large main exhibit (approximately 2,170 $ft^2$) with three levels. Features include a dirt area, mulch beds, a large, artificial tree stump with roots, indoor waterfall, and lagoon area. The reserve area consists of three reserves with a ledge in each. For this variable, trainers opened the gate between the large main exhibit area and the first reserve area. This allowed the tigers freedom to choose to be on or off exhibit during daytime hours (0900 - 1600). Refer to figure one for a diagram of the tiger exhibit and reserve area.

The second independent variable manipulated the times at which the tigers received their daily diets. Using a random time generator equation on Microsoft Excel, a completely random and unbiased schedule of feeding times for the tigers was produced. The trainers followed the randomized feeding schedule as daily schedule allowed, varying only slightly when needed due to trainer availability or tiger motivation. For example, at times the randomizer would create feeding times at 0700, 0703, and 1000. Since staff wouldn't be able to complete the 0700 session before the 0703 time, trainers would move that session to a more convenient time haphazardly.

The third independent variable was animal ambassador appearances at the tiger exhibit. The Aquarium is home to a large collection of animal ambassadors; the animals include an African crested porcupine (Hystrix cristata), a binturong (Arctictis binturong), a North American River Otter (Lontra canadensis) and an assortment of snakes, lizards, and birds. Using positive reinforcement training sessions, these ambassadors were presented in front of the tiger exhibit throughout the day for the tigers to view. Photo one is of an ambassador North American River Otter making an appearance in front of the tiger exhibit for this trial.

The fourth variable, novel enrichment, was given to the tigers each day. To be considered as novel the item had to be something outside of the daily enrichment items offered and not something the tigers had received during the study. A thirty-day calendar was created that specified which enrichment was to be presented to the tigers daily. The enrichment included both food and environmental enrichment devices. Items were selected based on previous frequency and by researching what other facilities offer their tigers. An item would not be considered "novel" if the animal had received it in the last three months or if it had ever been a normal item in the animal's rotation.

The fifth independent variable was offering the tigers a chance to participate in a training session at the acrylics in front of the tiger exhibit at least one time during the day. The time of day was determined each morning during pre-shift when the schedule for the day is decided. The exhibit training sessions involved a trainer calling a tiger to the acrylic for their training session, using a double whistle blast. The trainers would then ask different behaviors at the acrylic and throw reinforcement over the acrylic for the tigers. These exhibit training sessions were already in the tiger's behavioral repertoire and were conducted on average of two times per month on a normal basis. Photo two displays an exhibit training session with one of the three Sumatran tigers.

The sixth and last variable involved a random list creator custom equation through Excel. All the possible pairings of the three tigers, locations, holding arrangements, and number of shifts per day were entered into this equation. The result was a randomized chart that informed the trainers of exactly where the tigers should have been each shift and how each holding was to be set up. This minimized the chance of unconscious habits developed by trainers and allowed each shift to be strictly random.

Each trial had an approximate duration of thirty days, including that of the control variable. To find the dates for each trial, refer to table one.

An ethogram was developed to catalogue the behaviors exhibited by the tigers throughout any given day. With the animal's behavioral repertoire established, three categories were formed to analyze the data: desirable behaviors, undesirable behaviors, and nothing behaviors.

Desirable behaviors were defined as natural behaviors that trainers work to encourage and would be used in a measure of positive welfare. These behaviors also tend to be perceived by guests as a positive behavior. These behaviors were:

- Eating/Drinking
- Locomotion
- Swimming
- Running
- Play Chasing
- Playing with Inanimate Objects
- Solitary Grooming
- Social Grooming
- Mating Behavior
- Contact Vocals
- Other Solitary
- Other Social

Undesirable behaviors were defined as those behaviors that the guests, staff, and the literature perceive as negative behavior to be exhibited by the tigers. These behaviors were:

- Repetitive locomotion
- Repetitive grooming
- Dominance

The authors were left with a couple behaviors that were natural for the tigers to exhibit. These behaviors however often left the guests with a less than desired experience. The authors chose to exclude these behaviors from analysis since while they were natural behaviors, they did not help reach the goal of creating memorable guest experiences with active animals. These "nothing" behaviors were:

- Sleeping
- Not Visible to Camera

***Data Collection***

With the use of instantaneous sampling and recorded camera data of the tiger exhibit, the authors recorded the behavior displayed by the tiger every half hour during the day and every hour from 2430 to 0630. Once the data was collected, the author would then count how many desirable, undesirable and nothing behaviors that were exhibited by the tigers that day.

In addition, there was an observation sheet for the aquarium's staff and volunteers to record the tiger on exhibit's behavior and the time the observation was taken. These observations were taken at random times throughout the day. Along with the help of the aquarium staff and volunteers, the security guards would record the behavior of the tiger on exhibit four times throughout the night. This helped verify the accuracy of the camera recordings. All the above data collection procedures allowed the author to have a base of data for statistical analysis.

**Results**

The number of individual behaviors observed during each trial was added together to create a lump sum. The sum of desirable, undesirable, and nothing behaviors was also totaled for each trial. A chi-square test was performed in Excel to determine the significance of the differences in desirable behavior seen during each trial for all tigers. The trials were compared overall and then each trial was compared back to the control. The same procedure was repeated for undesirable behavior also. Refer to table two for a display of the overall trial chi square and p value results.

During the control trial, behavior categorized as desirable comprised 37% of Marah's behavioral repertoire. The two trials that produced the greatest increase in desirable behavior for Marah were the novel enrichment trial (p=3.998E-6) and the randomizer trial (p=0.0031). Exhibit sessions increased desirable behavior to 59% (p=0.0046). Access to reserve increased to 43% (p=0.003) and varied feeding times (p=0.001) and ambassador appearances (p=0.002) had the least effect by increasing only to 39%. Refer to table three for values of Marah's desirable and undesirable behavior by trial. Graph one is a visual representation of Marah's desirable behavior by trial.

During the control period, undesirable behavior accounted for 3% of Marah's behaviors. Novel enrichment (p=0.002) and exhibit session (p=0.006) trials had the greatest effect on decreasing undesirable behavior. Varied feeding times (p=0.007) and randomizer (p=0.013) decreased overall undesirable behavior to 1%. Access to reserve area (p=0.01) decreased overall undesirable behavior to 2%. Graph two depicts Marah's percentage of undesirable behaviors observed for all the trials. Ambassador appearances (p=0.002) increased the amount of undesirable behavior observed.

The trial that increased desirable behavior the most for Besar was the exhibit session trial (p=0.005). Exhibit sessions increased desirable behavior to 71%. The next greatest impact was during the ambassador animal trial (p=0.05) increasing desirable behavior to 64%. The following trials didn't have a statistically significant effect on behavior: access (p=0.057), varied feeding times (p=0.056), and the randomizer (p=0.057). The novel enrichment trial did not have a statistically significant effect on behavior. Refer to table four for the p values of Besar's desirable and undesirable behavior by trial and graph three for a visual representation of Besar's desirable behavior by trial.

All trials had an effect on decreasing Besar's undesirable behavior. During the exhibit session trial, no instances of undesirable behavior (p= 0.00036) were witnessed. The animal ambassador trial (p=0.00056), randomizer trial (p=0.00043), and novel enrichment trial (p=0.00036) decreased undesirable behavior to 1%. The access trial (p=0.00058) and the varied feeding times trial (p=0.0008) decreased undesirable behavior to 2%. For a visual representation of Besar's undesirable behavior by trial, refer to graph four.

The only trial that significantly increased Jalan's desirable behavior was the randomizer trial (p= 0.0008). This increased Jalan's desirable behavior to 58%. The changes for the other trials could not be associated to anything

other than chance based on chi-square test. For the p values of Jalan's undesirable and desirable behaviors, refer to table five and also refer to graph five for Jalan's desirable behavior by trial.

The randomizer trial for Jalan had the greatest effect on decreasing undesirable behavior (p=0.0002). Followed closely by novel enrichment (p=0.0001) and varied feeding times (p=0.024). Access to reserve (p=0.018) and ambassador appearances (p=0.021) did decrease undesirable behavior. Exhibit sessions did not appear to have an effect on undesirable behavior; see graph six for a visual representation of this.

Some limitations on these data included our small sample sizes, difficulty deciphering behavior on the camera, limited recording time which resulted in the loss of some data, and limitations of the views available on the camera. Marah's most common abnormal repetitive behavior, pacing, occurs with limited camera view. Besar's most common abnormal repetitive behavior is repetitive grooming and can be hard to distinguish from regular grooming. When multiple tigers were out it was difficult to tell the difference between individuals. There were three different individuals recording data from the camera, which could lead to discrepancies and subjective categorizing. Desirable behaviors also tend to be shorter in duration than undesirable and nothing behaviors; this could make them harder to observe on camera with our instantaneous sampling methods.

**Discussion**

All three tigers responded positively to the randomizer trial. This trial landed in the top three for all three tigers in increasing desirable behavior and decreasing undesirable behavior. The rest of the trials seemed to impact each animal uniquely (refer to table six for each animals' top trails). The top three was determined by taking the highest percentages of desirable behavior for Besar and the highest percentage of undesirable behavior for Marah and Jalan.

For Marah, implementing all 6 trials in some combination would be effective at increasing desirable behavior and decreasing undesirable behavior. The three variables that had the largest increase on desirable behavior were novel, exhibit sessions, and the randomizer trial. This is supported by previous research that novel enrichment and training sessions have shown to be successful management strategies as well (Claxton, 2011, Szokalski, Litchfield, Foster, 2012). These three (novel, exhibit sessions, and randomizer) increased desirable behavior from 37% to 59%-64%. Novel enrichment and exhibit sessions also decreased undesirable behavior to zero. Any management strategy should include novel enrichment and exhibit sessions at a higher frequency.

For Besar, all trials decreased undesirable behavior and the exhibit sessions and ambassador animal visits increased desirable behavior. A combination that leans heavy on ambassador appearances and exhibit sessions, but still includes the other variables as well could result in well-rounded behavior. It is possible that ambassador animals provide novel, olfactory, and natural predator response types of enrichment all of which have shown to be successful in enrichment options (Szokalski et al, 2012).

The randomizer trial had the greatest effect on both desirable and undesirable behavior for Jalan. All trials had an effect on decreasing undesirable behavior except exhibit sessions. Trainers observed that during the randomizer trial they were putting the tigers together more often than they felt they normally would. They had pre-conceived ideas that the tigers preferred to be alone rather than grouped in any combination with each other. Previous research indicates positive social stimulation can be a suitable and successful form of enrichment (Szokalski, 2012). It is possible the randomizer had more to do with social grouping increasing than the random effect itself. Future research could investigate this further to determine the significance.

After the conclusion of the study a calendar was created to incorporate all trials that had a positive effect on behavior and observations continued to see if there were observable differences (Table 7).

The calendar was effective at increasing desirable behavior and decreasing undesirable behavior for Marah. In Besar's case, the calendar decreased both desirable and undesirable behavior indicating a possibility of increased "nothing" behavior. For Jalan, the calendar decreased undesirable behavior but had no effect on desirable behavior.

**Conclusion**

It is helpful to the team of trainers to know objectively what trials produce which results rather than relying on more subjective methods of management. This knowledge alone has encouraged trainers to group the tigers more often than they would previously and to brainstorm more novel and creative enrichment options. While antidotal, staff reported an improvement in shifting breakdown over the course of the study. The calendar trial proved most effective for all tigers.

It would be helpful to repeat the control trial after each trial to ensure there was not a cumulative effect of the trials on the tiger's behavior. A repeat study with larger sample sizes and in person observation options would make for stronger results.

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*Table 1: Dates of data collection throughout trials*

| Variable | Dates data collected |
|---|---|
| Control | 4th of October thru the 13th of October 2016; the 4th of December thru the 12th of December, 2016 |
| Access | 14th of October thru the 21st of November 2016 |
| Varied Feeding Times | 5th of January thru the 26th of January 2017 |
| Ambassador Animal Appearances | 4th of February thru the 15th of February 2017; the 20th of February thru the 22nd of February 2017; 27th and 28th of February 2017 |
| Novel Enrichment | 12th of March thru the 2nd of April 2017 |
| Exhibit Sessions | 5th, 7th, 9th, 10th, 13th thru 18th, 22nd, 24th, and 27th thru 30th, of April 2017 |
| Randomizer | 24th of May thru the 14th of June 2017 |

*Table 2: Overall trial chi square and p value results*

| Tiger | Overall p | Undesirable behavior p | Desirable behavior p |
|---|---|---|---|
| **Marah** | 2.008E-12 | 0.00184 | 5.396E-06 |
| **Besar** | 0.0004 | 0.01075 | 0.16918 |
| **Jalan** | 2.28278E-08 | 0.02803 | 2.03017E-05 |

*Table 3: Marah's desirable and undesirable behavior by trial*

| Trial | # of desirable behaviors during trial | Desirable behavior % | p value (compared to control) | # of undesirable behaviors during trial | Undesirable behavior % | p value (compared to control) |
|---|---|---|---|---|---|---|
| Control | 108 | 37 | - | 10 | 3 | - |
| Access | 222 | 43 | 0.003 | 12 | 2 | 0.01 |
| Varied | 123 | 39 | 0.001 | 7 | 1 | 0.007 |
| Ambassador appearances | 107 | 39 | 0.002 | 7 | 4 | 0.002 |
| Novel | 155 | 64 | 3.998E-6 | 0 | 0 | 0.002 |
| Exhibit sessions | 121 | 59 | 0.0046 | 1 | 0 | 0.006 |
| Randomizer | 161 | 64 | 0.0031 | 3 | 1 | 0.013 |

*Table 4: Besar's desirable and undesirable behavior by trial*

| Trial | # of desirable behaviors during trial | Desirable behavior % | p value (compared to control) | # of undesirable behaviors during trial | Undesirable behavior % | p value (compared to control) |
|---|---|---|---|---|---|---|
| Control | 120 | 51 | - | 10 | 4 | - |
| Access | 297 | 58 | 0.057 | 10 | 2 | 0.00058 |
| Varied | 188 | 57 | 0.056 | 5 | 2 | 0.0008 |
| Ambassador appearances | 147 | 64 | 0.05 | 2 | 1 | 0.00056 |
| Novel | 181 | 60 | 0.0688 | 2 | 1 | 0.00036 |
| Exhibit sessions | 148 | 71 | 0.005 | 1 | 0 | 0.00036 |
| Randomizer | 171 | 63 | 0.057 | 2 | 1 | 0.00043 |

*Table 5 Jalan's desirable and undesirable behavior by trial*

| Trial | # of desirable behaviors during trial | Desirable behavior % | p value (compared to control) | # of undesirable behaviors during trial | Undesirable behavior % | p value (compared to control) |
|---|---|---|---|---|---|---|
| Control | 107 | 44 | - | 32 | 13 | - |
| Access | 220 | 43 | 0.0802 | 59 | 12 | 0.018 |
| Varied | 143 | 41 | 0.649 | 25 | 7 | 0.024 |
| Ambassador appearances | 112 | 48 | 0.235 | 29 | 12 | 0.021 |
| Novel | 120 | 39 | 0.336 | 11 | 4 | 0.0001 |
| Exhibit sessions | 93 | 30 | 0.489 | 25 | 11 | 0.0055 |
| Randomizer | 171 | 58 | 0.0008 | 2 | 3 | 0.0002 |

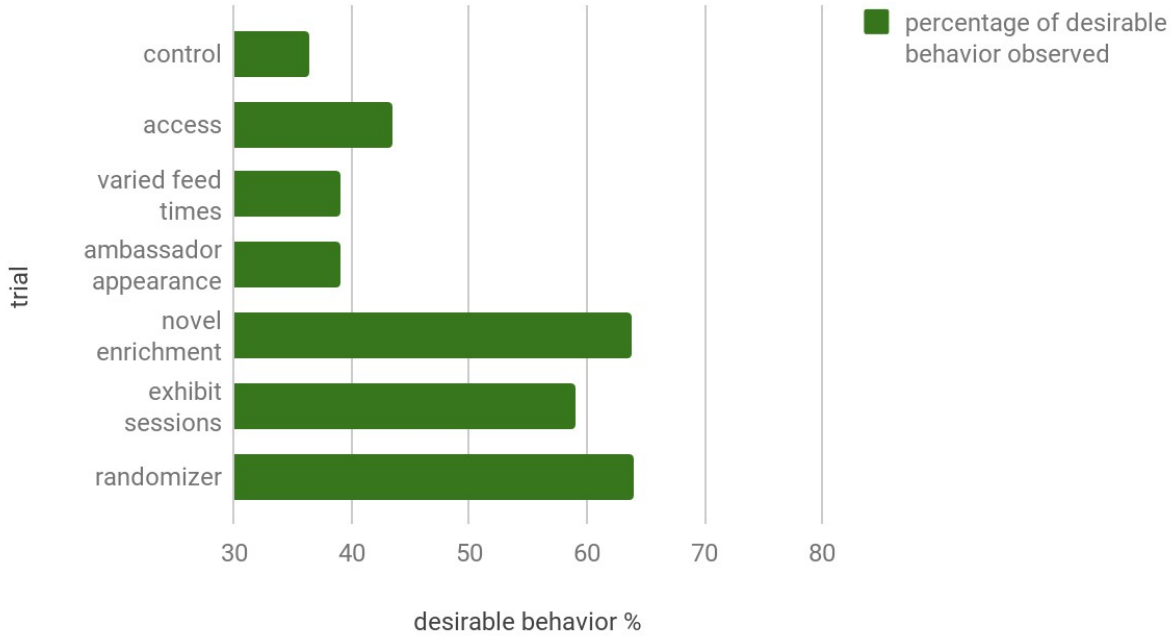
*Table 6: Most effective trials for all three tigers*

| **Tiger** | **Most effective** | **2nd most effective** | **3rd most effective** |
|---|---|---|---|
| **Marah** | Novel enrichment | Randomizer | Exhibit sessions |
| **Besar** | Exhibit sessions | Ambassador appearances | Randomizer |
| **Jalan** | Randomizer | Novel enrichment | Varied feeding times |

*Table 7: Calendar trial*

| Tiger | Desirable behavior percentage | | p values | Undesirable Behavior Percentage | | p values |
|---|---|---|---|---|---|---|
| | Control | Calendar | | Control | Calendar | |
| **Marah** | 36% | 53% | 0.001 | 3% | 2% | 0.02 |
| **Besar** | 51% | 48% | 0.0003 | 4% | 2% | 0.001 |
| **Jalan** | 44% | 46% | 0.59 | 13% | 3% | 9.2E-07 |

## Marah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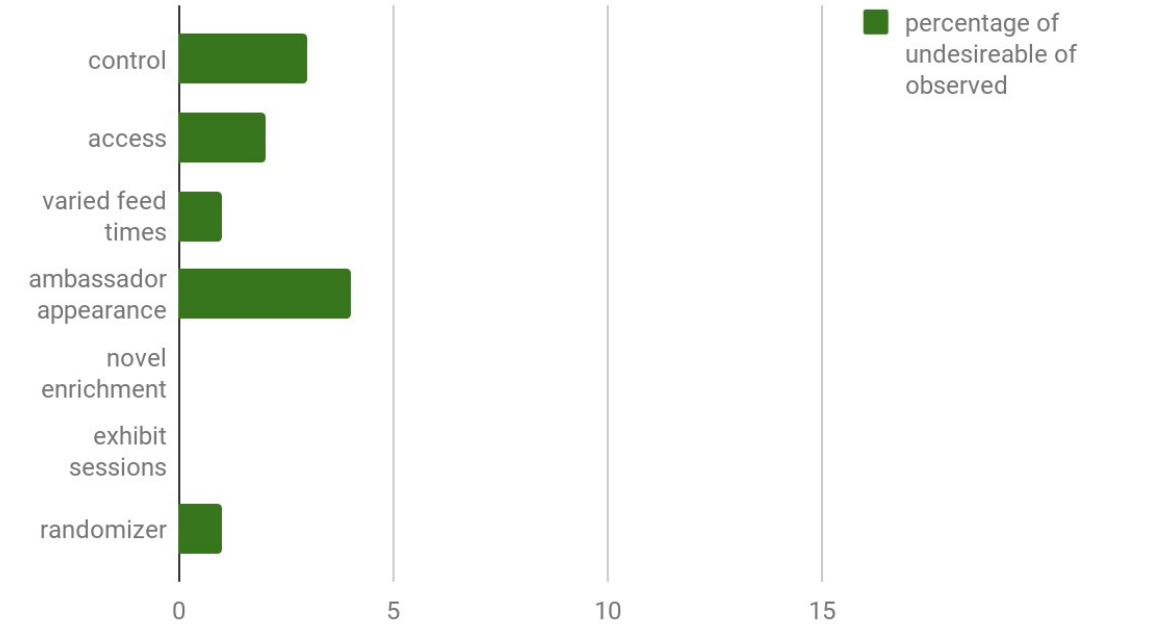
## Marah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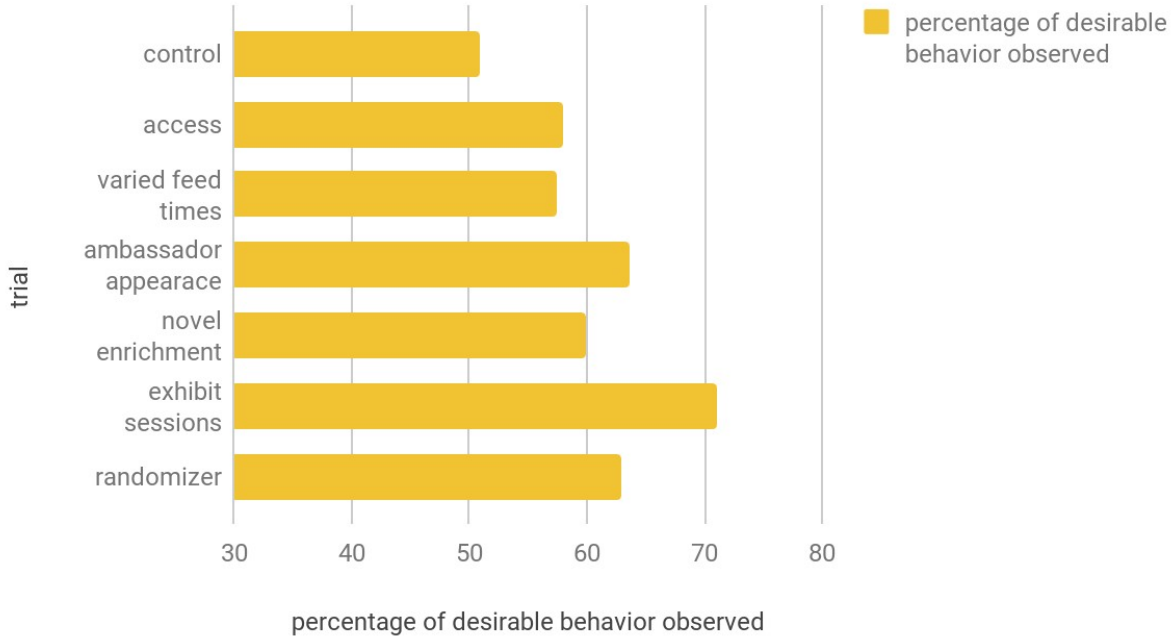
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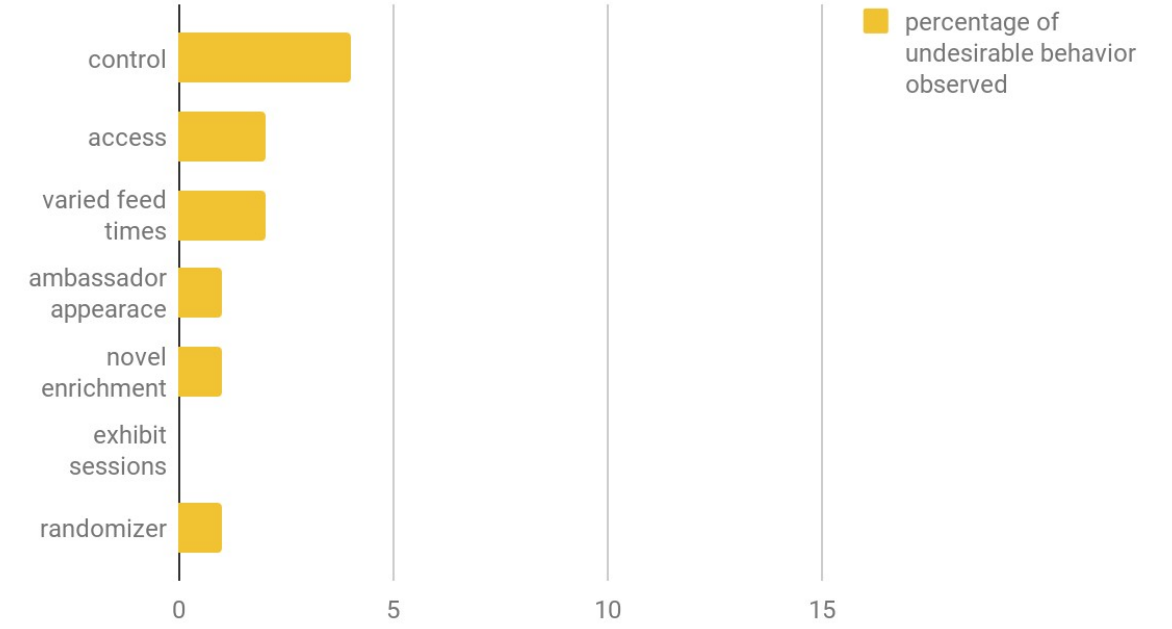
## Besar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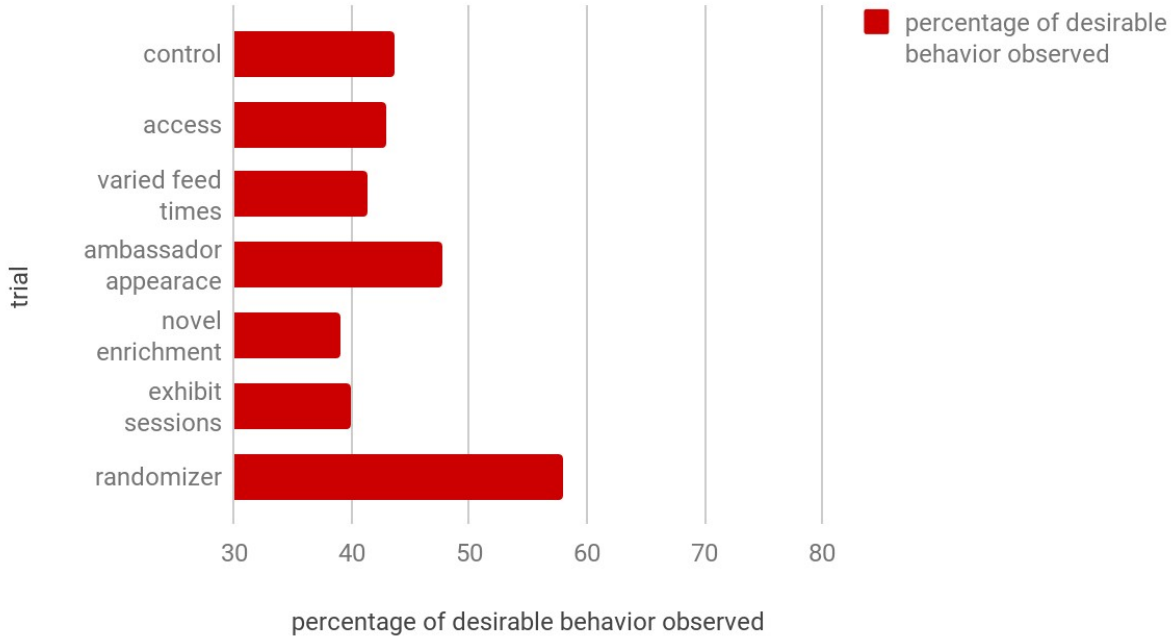
## Jalan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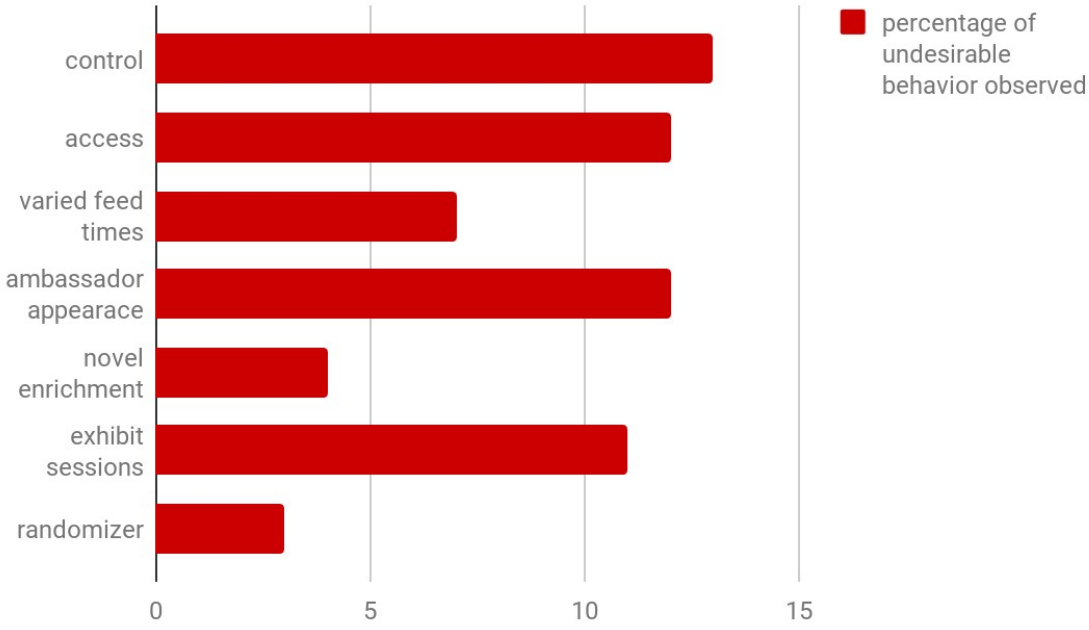
## Jalan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# Managing a Behavioral and Medical Rollercoaster for an Okapi female at Denver Zoo

***By***
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## Introduction

Denver Zoo is home to 3.2 Okapi (*Okapia johnstoni*) ranging in ages from 8 years to 6 months. Kalispell (Kali) is an 8-year-old female okapi born at Denver Zoo. As an accredited institution of the Association of Zoos and Aquariums (AZA), Denver Zoo participates in the Okapi Species Survival Plan® (Okapi SSP). Following recommendations from the Okapi SSP®, Kali was paired with a male named Sekele for breeding in 2012. She gave birth to her first calf in February 2014 at 4.5 years of age. It was after this birth that her behavior, health and training compliance began to change rapidly and has continued to take her keepers on a rollercoaster ride over the past three years. It was only shortly before the birth of her second calf in December 2017 that Kali's rollercoaster seemed to be coming to a stop.

## The Rollercoaster I—Excessive post-partum body condition loss

Kali was proving to be an excellent first-time mother to her calf, a male named Jabari. Jabari was following all growth and behavioral milestones as referenced from the AZA Okapi Husbandry manual. Kali seemed to have a great supply of milk and was nursing Jabari well. She was as attentive as she needed to be but also not overbearing. She continued to maintain positive relationships with keeper staff while allowing them to form bonds with Jabari as well. However, just 2 months post-partum, keepers noticed that Kali was continuing to loss a significant amount of weight, more than normal post-partum loss. Continued body condition loss was reflected in her thinning along the hips and vertebrae but still maintaining a larger abdomen. Denver Zoo veterinarians assessed Kali's condition and a plan of action was formed and applied.

After looking at many factors including behavior and diet, it was hypothesized that Kali just was not getting enough to sustain both herself and her calf at normal growth rates. Staff veterinarians consulted with the Okapi SSP® along with other institutions as recommended, including the Chicago Zoological Society. Diet adjustments were suggested and put into action in late April 2014. Adjustments included soaking alfalfa in water, adjusting amount of grain offered, and addition of supplemental grain to boost caloric intake. Kali remained bright, alert, and responsive while continuing to consume all offered food items, but keepers observed additional symptoms that suggested there might be other things going on. Kali's coat became rough and patchy and her fecals were changing in consistency even though she was consuming her now increased diet, she was still acting ravenous and losing weight. With these new symptoms, it was thought that there may be some metabolic abnormalities that could be the cause of her weight loss and declining skin condition. The most efficient way to test for metabolic abnormalities is through blood sampling. Because Kali was regarded as a gentle dispositioned animal and had formed such strong bonds with her keepers over the years, it was determined that she would probably train well for voluntary blood draws from her jugular vein.

Training programs at Denver Zoo are primarily choice based using operant conditioning and positive reinforcement practices whenever possible. A training plan was formed and started in June 2014. In addition to training for a voluntary blood draw, keepers began to assist wean her calf by separating them for longer sessions during the day. The calf was eating solid food well on his own and with okapi being a solitary species that "hide" their young, this was not a difficult task. Both Kali and Jabari did well separated for a few hours a day. The separation seemed to eliminate at least one nursing. The hope with Jabari weaning earlier than the normal 9-12 months was that Kali would not have to use so much of her reserve to keep up with Jabari's growing body. Her body just did not seem to be handling it well.

Training for the blood draw went very well from the beginning. Kali had a good history of engaging in training sessions and other miscellaneous interactions with her keepers (shifting, health checks, behind-the-scenes tours, etc.). At the time of initial training, okapi at Denver Zoo were managed in a free contact setting for many of their husbandry needs however, it was decided to train this behavior in a restricted contact setting allowing for additional staff safety especially since there would be staff that she would not be familiar with participating in the sessions.

Kali was trained to position her body parallel to a sliding stall door while her head and neck were positioned using a target behavior. She was very familiar with the space and set up as it was where abdominal ultrasounds were done during her pregnancy. Kali is a tolerant individual when it comes to training and usually grasps concepts in a reasonable timeframe. The first attempt at a sample collection was done 21 July 2014. Kali had worked this behavior with multiple people playing the role of the veterinarian. For some reason, she was more nervous for the first actual attempt. She did allow for two attempts at getting a sample but no luck. Because of her nervousness, it was decided that one of the zoos veterinary technicians would be assigned to the case and participated in sessions from this point forward to just build the relationship with Kali.

At five months post-partum, July 2014, Kali's body condition and weight loss had been in steady decline even with adjustments in diet from type of grain changed, amount offered increased and continued soaking of alfalfa with a hundred percent compliance in consumption. Kali was also exhibiting some signs of weakness when walking and staff veterinarians confirmed muscle atrophy in both of Kali's hind limbs. Additional clinical tests were performed, and she tested positive for parasites. A five-day course of treatment begun 01 August 2014. There was also some concern with how her hooves were wearing with her adjusted gait and movements from being weak. As part of her husbandry, Kali is trained for standing hoof trims and had routine visits from a consulting farrier, Steve Foxworth with Equine Lameness and Prevention Organization. Even with her health issues, Kali still engaged in all her training sessions and allowed Steve to work on all four hooves on his visit 5 August 2014.

Training continued for blood draw and on 15 August 2014, the first collection of 18 milliliters was obtained! This was a huge success as it meant further clinical diagnostics for mineral panels, metabolic abnormalities, and normal chemistries could be done. Results from the bloodwork indicated that additional testing and samples of other bodily functions were needed. Over the next few days, keepers collected urine and fecal samples. The one that posed the biggest challenge was a wanted "sterile" milk sample since she was still nursing her 6-month-old calf. How do you milk an okapi? It is not an easy thing to do but because of the good relationship that Kali has with her keepers and her allowing full body tactile, we were able to obtain a small sample. There were no issues associated with her milk, urine or feces. An abdominal ultrasound was completed via training, and it was suspected that she might have small bowel enteritis due to mildly increased abdominal fluid and gastrointestinal hypermotility. Due to these findings, a course of antibiotics was begun immediately.

The antibiotic treatment that she needed was to be administered intramuscularly but Kali was not yet trained for injections, so she had to be darted. It was known from her history that a pole syringe made her much more nervous and it was less stressful to her to be darted. The treatment course included multiple darts every 2-3 days for approximately one week. Frequent darting with antibiotics had keepers slightly concerned that Kali might regress with her blood draw behavior which needed to be maintained for rechecks required after treatments. Unfortunately, due to the okapi's thick skin, darts do not come out easily on their own. Keepers remove them which make the okapi a little nervous the first few times and Kali was no exception for this. Despite the treatment protocol, Kali laid keepers concerns to rest and continued to be amazing with her blood draw behavior. Additional blood collections were obtained on the 25 August 2014 and 8 September 2014 through training. Her continued compliance and eagerness to train was amazing. Veterinarians consulted an animal nutritionist regarding the mineral panels and additional adjustments were made to Kali's diet. The blood draw behavior was maintained and passed to a second keeper as Kali's primary keeper went out for maternity leave at the end of September.

Over the course of the next few months, Kali was taking large strides in recovery. Keepers continued to separate her from her calf during the day to speed up the weaning process. Her weight was still decreasing with the recent adjustments even with a hundred percent consumption compliance. Another round of diet adjustment were made in October 2014 as instructed from the nutritionist. Adjustments included transitioning to a different type of grain, the addition of supplements and reduction in produce. Her weight then began increasing, and her body condition began to increase and stabilize.

**The Rollercoaster II—Post Weaning GI problems**

Jabari was fully weaned and managed as an adult by the time he was 13 months old which correlated with Kali continuing to increase her weight and body condition. Additional diet modifications where made at the beginning of 2015 which also contributed to the rise in body condition. However, on 4 April 2015, Kali had a sudden onset of abnormal behavior. She became dull, lethargic and inappetent. There was a suspicion that she browsed on common buckthorn (*Rhamnus cathartica)*, which was a concern as it is a gastrointestinal and hepatic toxin. Buckthorn is a

fast growing, invasive species and was found growing through a fence adjacent to the okapi exhibit where the okapi are known to browse. Even after the buckthorn was removed, Kali still was not eating her normal diet well and with very little interest in the grain portion. After discussing with staff veterinarians and nutritionist, it was decided to switch Kali back to her original diet pre-calf and see if that made a difference. The switch seemed to be what she needed as she began eating her grain ration again. Kali seemed to come out of whatever distress she was in.

At the beginning of 2015, we housed 3.1 okapi (a mature male, a young mature male, a juvenile male and a mature female). Okapi are a solitary species and housing this arrangement created challenges for keepers that we had not yet experienced. Keepers noticed some behavioral changes from Kali that indicated she may have been coming back into regular cycles. These changes included audible vocalizations at shared fence lines with the males, pacing overnight and occasional head tossing. There was no evidence of these behavior modifiers when she was with her calf. Keepers tried to mitigate the more negative behaviors by rotating housing which seemed to work for a short time.

Kali's behavior did not seem to change much depending on where the males where in relation to her but there were behaviors from the males that needed to be mitigated. The eldest male, Sekele, seemed to react more to Kali when she was cycling. He would pace the fence line and vocalize to her. If he shared a fence with the younger male, Molimo, he would instigate sparing at the fence. After the males injured themselves a few times, the open fence lines were covered with a solid wood screening and the males no longer shared fence lines. Okapi estrous cycles are every 14-18 days with estrus being 2-5 days in length. This made housing a little more challenging for keepers due to the behaviors that were observed during these times. Keepers came up with a rotation plan so that each okapi would have time in each of the two exhibit yards and use of the three back holding areas. To add to the daily challenges and excitement of this population, we received confirmation that we would be adding to our okapi population and received a young female, Almasi, for breeding from Dallas Zoo, who arrived in May 2015.

Discussions for how to proceed with the breeding recommendations from the Okapi SSP® were conducted and the team decided that due to current housing constraints, zoo construction in adjacent animal areas, schedule of upcoming routine maintenance and weather to not introduce pairs together until there was a little more room. Jabari was scheduled to leave for his new home in the spring of 2016 which would then open the space needed.

Throughout the year, there were multiple changes to the daily routine of all the okapi. Construction in animal exhibits surrounding the okapi yards, miscellaneous painting/maintenance projects inside the barns, etc. Okapi housing arrangements were changed multiple times. They would get shifted back and forth from barn to barn, stall to stall. It was decided to attempt introducing the two females together to not only assist with some housing constraints but to also provide more companionship which might help mitigate stressors or negative behaviors. Kali and Almasi were introduced 10 October 2015 and remained together until 16 March 2016. Housing them together went well with the occasional hiccup. Almasi, at two years old attempted to nurse from Kali a few times but Kali did not let her. Almasi is larger than Kali and she would get a little too physical at times. Keepers would monitor and separate out if needed for short times. Because we were still trying to keep Kali's weight and body condition at good levels, the females were separated for the grain rations of their diets.

Kali experienced another onset of symptoms suggestive of repeat exposure to common buckthorn on 11 February 2016. Common buckthorn was again removed from potential browsing areas. Symptoms seemed to dissipate on their own with careful monitoring and slight changes applied to her diet. In addition to the grain and alfalfa portions of her diet, browse was increased and produce trials began. The okapi at Denver Zoo had historically received some produce in their daily diet and for training. The purpose of the produce trial was to get them on more consistent produce intake which would in turn help regulate their gut if there was not constant change. Kali had begun to be inconsistent with training and was refusing previous produce offered. The trial gave keepers more options of items to try. With Kali not taking any reinforcer, training was near impossible.

**The Rollercoaster III—Continuous breeding behavior**

Jabari was relocated to his new home in Omaha, Nebraska in April 2016 which enabled discussions of breeding the two pairs to be reinitiated. It was decided that we would concentrate on Kali and Sekele since they had been a previous established pair while Molimo and Almasi were younger and had never been with a mate. Kali was making this decision difficult. She was continuing to exhibit unusual behaviors around estrus cycles. She was continuing to pace, head toss, vocalize and be non-compliant with any training. She also regressed with her behavior towards

keepers. Kali would head toss and walk away most days not wanting any food or attention. This behavior alerted keepers as to something continuing to be off. The unfortunate portion was that even though Kali had previously been trained for bloodwork, with her being standoffish for any interactions, it was not possible to get blood to aid in any diagnosis of her problems.

For no lack of trying, the last successful blood draw for Kali was on 8 September 2014. Without her compliance, the only way for us obtain a blood sample was by doing so with her under anesthesia. It was decided to keep trying via training and if Kali started to show more unusual symptoms of anything, anesthesia would be done. Kali was not very participatory in training sessions and discontinued eating some of her favorite food items. Kali usually had a calm and gentle disposition toward keepers but continued to be "standoffish" and uninterested. She stopped approaching keepers for training sessions, she slowed/stopped shifting to areas. She continued tossing her head up if she seemed agitated with a situation. Sometimes, it would happen in the middle of a session and the session would stop. Other times, she would exhibit unwanted behaviors if keepers just entered the stall with her.

Looking at calendars and training records, it seemed to be that Kali's more severe behavior challenges seemed to correlate around her cycle. Kali had still not been bred since she became pregnant with Jabari in December 2012. Was the fact that she was housed next to males and not breeding contributing to her behavior? There were also instances where Kali appeared to be in pain in between cycles. She would hunch her back and pull her stomach in. She would stand in one place and do that repeatedly then move slowly somewhere else. Because of the increased pain aspect now incorporated with Kali's cycles, the possibility of Kali having follicular or some other kind of cyst or reproductive issue was discussed in depth. Kali's behavior of late seemed as if she was cycling all the time. Fecal samples were collected for hormone analysis and an exam was scheduled.

A full medical exam under anesthesia was performed 14 July 2016 with assistance from reproductive specialists from Colorado State University. All aspects of the exam were within normal limits. However, there was a right ovarian anovulatory follicular cyst. The cyst was thick walled and twice the size of the left ovary. Kali's uterus and left ovary were normal. The treatment of the cyst would depend on the results from hormone panels.

Based on hormone results, treatment with prostaglandin was attempted two weeks after the exam. However, treatment did not seem to have the desired effect. Kali was still exhibiting behaviors of increased estrus cycles. She was observed snorting, pacing, tossing her head, etc. Keepers also noticed more vulvar swelling than usual. These behaviors only seemed to last a day or so before Kali was acting normally again.

Kali underwent a second exam under anesthesia for a recheck on 16 August 2016. During this exam, a smaller follicle on the right ovary was observed. The appearance of follicular growth on the ovary and the edema in the uterus were compatible with a high estrogen environment and it was decided to introduce Kali with Sekele as soon as possible but to give her additional hormone treatments just before being introduced to encourage breeding.

Kali and Sekele were introduced to on 21 August 2016 with little issue as they were already an established pair. Kali was seen submitting to Sekele quickly and breeding attempts followed. The pair was left together during the day but separated overnight for better monitoring of breeding, consumption of diet and fecal quality. Multiple successful breeding attempts were documented over the next few months. At the beginning of October, Kali had an unusual episode of displaying as if she was in prolonged estrus again. Sekele was beginning to get more agitated and Kali would have additional small wounds on her sides at the end of the day as if she was not complying with him. It was decided to separate the pair until further notice as we did not want the agitation from Sekele to escalate toward Kali.

Kali had another behavioral episode a few days after separating the pair. She was agitated, and her body posture was tense. It was decided to give follow-up treatment with additional hormones as done previously. A few weeks after hormone treatment and being separated from Sekele, Kali seemed to "flip a switch." After not training well for months and having little interest in keepers, she was suddenly engaged in training session and taking produce again. Because of the multiple confirmed breeding encounters that she had with Sekele, ultrasound training was begun again. She had not been worked with the behavior since the birth of her calf in February 2014. Kali was doing well with keepers but did not want to participate with the veterinarian. Kali also still had the occasional episode of being agitated and not wanting to comply with anything asked of her. Those days, she was just left alone. Keepers did not want to ruin any relationship with her by trying too hard.

A new ultrasound machine was acquired for the zoo that could be monitored remotely via local wi-fi. That way one person (trusted by Kali) could perform the ultrasound while it was watched in real time by additional staff outside the stall. Because Kali was doing well with ultrasound training regarding equipment, alcohol application, and pressure on abdomen but still not allowing multiple people in the stall with her to preform an ultrasound, this new equipment enabled keepers to preform the ultrasound with guidance via radio from the reproductive specialist and veterinary staff outside the stall reading the monitor. Pregnancy was confirmed via ultrasound on 17 April 2017!

Kali's behavior began to change drastically again over the next few weeks. She was much more relaxed and participated in training session eagerly. Staff began attempting to introduce a second person for ultrasound and Kali remained calm. Kali began allowing our research manager/reproductive specialist, Anneke Moresco DVM PhD, to join the keeper in the stall with her for ultrasounds. Ultrasounds were done biweekly for continued monitoring of the fetus.

With Kali's positive behavior change, she continued to work all other behaviors except her bloodwork. During some of the ultrasounds, the fluid in the uterus appeared more cloudy than usual. A possible reason for the cloudy fluid was infection which could have been confirmed by blood results. Since Kali was still not participating in training for blood draws, it was decided to perform a standing sedation so a blood sample could be obtained for further diagnostics. The sedation was performed on 29 May 2017. Bloodwork revealed no infection. After the procedure, it took a few days for Kali to be accepting of keepers in her stall for ultrasound training. This was totally expected but on the second day, keepers were able to go in and felt fetal movement.

Kali transitioned back to allowing Dr. Moresco to preform ultrasounds via training sessions within a week. The fluid in the uterus was clearing up. Abdominal ultrasounds began to be done less frequently as the fetus grew. They went from being done biweekly to monthly. Kali remained compliant and eager to train during these sessions. She did begin to get less compliant during farrier visits and hoof work sessions, but it was suspected that the excess body weight from pregnancy made her uncomfortable.

**The Ride Ends:**

Kali gave birth to a second male calf (as determined via ultrasound), named Forest, on 4 December 2017. Kali's behavior never faltered after the birth of this calf. She has remained eager to participate in training sessions and continued relationship building with her keepers. She has proven to be a fantastic mom once again. Keepers and veterinarians were ahead of the weight loss this time post-partum and Kali has been thriving. Her body condition and weight loss have remained within expected limits. Forest is growing well and has been observing Kali during training sessions. He is still a little weary of keepers but has recently begun approaching more and participating in his own training program.

Management continues to be challenging with two breeding pairs of okapi and a calf, but with the help of the Hoofstock team, the Animal Health department and so many more working together to come up with suggestions and action plans, Kali's roller-coaster seems to have come to a stop. Kali's behavior is closely monitored for any signs that she is coming back into estrus as she is 8 months post-partum at the time writing. Kali and Sekele have a continued breeding recommendation from the Okapi SSP®. Hopefully, we will be able to introduce this pair back together and continue the support of a growing okapi population.

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Association of Zoos and Aquariums

**Giraffe Population Survey & Collaring with the Giraffe Conservation Foundation**
Authored by Kendall Thawley

When I was assigned to organize the activities for World Giraffe Day at The Houston Zoo in 2014, I was a bit confused. As far as I knew giraffe weren't endangered, there wasn't a lot of conservation messaging surrounding them, and I wasn't really sure what our take home message was going to be for the public. So I started doing some research and was shocked. Habitat loss, civil unrest, and poaching were all threatening giraffe. In fact, giraffe populations were declining across Africa and few people were aware of it. I was a giraffe keeper and I wasn't even aware of it! So we got to work, trying to raise awareness of the issues that giraffe populations face and raise support for the Giraffe Conservation Foundation (GCF). It quickly became a passion project of mine. I found myself talking more and more about the threats they face in the wild when giving Keeper Chats and Behind-the-scenes Tours of our giraffe areas. I talked about the research being done by the GCF and how there was still a need for more and I always got asked the same question. "Have you ever been to Africa to see the giraffe?" and my standard response was always "No, but I'd love to go someday!"

About 3 yrs later, I boarded a plane to travel to Namibia to join the GCF on a trip into the Namib Desert for a giraffe population survey and collaring attempt. The giraffe in the area roam through very arid landscapes alongside many species of megafauna such as elephant, black rhino, lion, leopard, cheetah, springbok and gemsbok. They travel along dry riverbeds, eating from the trees and bushes that survive on what little rainfall the area gets each year. The GCF's project in Northwest Namibia is one of the longest running studies of wild giraffe, going back over a decade. The information they gather can be used to determine the giraffe population of the area, estimate the life span of wild giraffe, provide information on the diets and browsing habits of wild giraffe, and help plan future conservation efforts in the area. As one of the few populations of giraffe that is actually growing, information gathered from studying them could prove useful to managing other populations elsewhere in Africa.

Each of our days in the field started much the same way, waking up as the sun rose and eating breakfast around the fire. We'd pack a lunch and load equipment into the truck then take off to drive up and down the dry riverbeds of either the Hoanib or the Hourasib rivers for most of the day. Everyone would keep their eyes peeled for giraffe, and when a herd was spotted its coordinates and group size was recorded. The species of plant they were browsing on was documented and several photographs were taken of each individual. Those photographs were then compared to the photographs already on record of individuals seen in the area. Giraffe spot patterns are as unique as human fingerprints, no two giraffe have the same spot pattern and the spots don't change as the giraffe grows, so positive ID's of individuals can be made by comparing spot patterns. Once all the individuals in a group were photographed and identified we would move on to look for more.

The real rodeo began in the three days that we spent attempting to collar a few individual giraffes. First we had to find a good candidate. Putting a collar on a giraffe that was too young could cause fit issues as the giraffe continued to grow, but choosing a giraffe that was too big would make it difficult to safely bring down. Once a giraffe of appropriate age and size had been discovered, it would have to be darted with a powerful opioid to sedate it. Once it was sedated we would attach a collar to its ossicone to allow for remote tracking, a process that only took a few minutes. The problem is that giraffe have a tendency to run away between those two steps. In my limited experience, the giraffe didn't run when they initially got hit by the dart, they ran when they begin to feel the drug take effect. At that point their vision is compromised and their breathing labored, so an extended period of running is highly dangerous. It was our priority to bring them down as quickly as possible and administer the opioid's reversals. It makes sense on paper, it seems almost easy. In reality, this plan means silently crouching in the bed of a pick-up truck with six other people for long periods of time as the driver crept up on the giraffe that was chosen, then hanging on to each other for dear life as the truck sped over all kinds of terrain following the giraffe once it ran, then leaping out of the back of the truck and running towards the giraffe to trip it up with a long rope and bring its head down to ground level, leaping to grab its head to hold it down while the reversals were given and then sitting on the neck of a fully awake, non-anesthetized wild animal for about 10 minutes while the collar was put in place and other measurements and samples were gathered. My sprinting skills left a lot to be desired, but with each chance I got, I got better. Once the collar had been attached, we simply had to take our body weight off the giraffe's neck and within a matter of moments the giraffe would stand up and be on its way.

Beyond just the usual general knowledge and experience that I gained from my time with the GCF, by observing the people that live in the region I also began to understand some of the challenges that conservationists in the field face. When local people's whole livelihood depends on their herd of goats, lions constitute a very real danger to a family, both physically and financially. Their homes are made of tarps strung across a frame of sticks, in areas where people are occasionally killed by elephants. It's easy for us as zookeepers to stay half a world away, and wonder why people can't just learn to live alongside elephant and lions and such. We view our proximity and familiarity with these animals as a privilege, and often can't understand why others don't. But being awoken by the rumbling of an elephant not two feet away from my tent wall in the middle of the night helped remind me of the danger involved. Empathy and understanding is crucial to finding long-term solutions to the threats that both animal and human populations face. This trip provided me with a new perspective on how conservation is to be approached.

In total, we spent about 10 days in the field, added collars to 3 giraffe and identified 156 individuals. Getting hands on experience with giraffe sedations in the field was incredibly educational, and I now have more confidence during sedations at my job as a result. I was surprised to discover how fluid the wild giraffe's herd structure seemed to be. We found groups

of all ages and genders, and individuals seemed to change groups regularly, daily even. I learned about their browsing habits and observed the way they interact with other species. It's difficult to articulate everything that I learned from the trip, but by the end I felt better equipped to care for the giraffe at the Houston Zoo and to communicate with our guests about the challenges that their wild cousins face and what can be done to help them. I think most of us as Keepers dream of being able to observe and work with our favorite species in the wild, and I am grateful and honored to have had the opportunity.

# AAZK Conservation, Restoration, and Preservation Grant: Installing Bird-Safe Film and Educational Kiosk to Conserve Migratory Birds

By

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Kill lights. Save birds. This is the goal of Lights Out Baltimore, a non-profit striving to make Baltimore safe for migratory birds. Birds migrate by navigation of the moon and constellations and become disoriented when flying over brightly lit cities. The birds misguided by the lights enter the urban environment. Once in the city area, buildings made with an abundance of clear or reflective glass become a deadly trap. It is estimated that as many as 1 billion birds die from building collisions per year in North America alone. To combat that, there are about 25 estimated lights out or safe passage programs across the country striving to raise awareness of light pollution, glass collisions, and conserve migratory birds.

During fall and spring migration, a crew of Lights Out Baltimore (LOB) volunteers monitor a 5-mile route downtown comprised of 15-20 buildings to save birds and collect the ones that did not complete their journey through Baltimore. All of the dead birds are donated to the Smithsonian's Natural History Museum and the injured ones are transported to a local wildlife rehabilitator. Since 2008, LOB has rescued 1012 and collected 3009 deceased birds (98 species) from the downtown route.

In addition to daily monitoring during migration season, LOB advocates for efficient lighting practices to reduce light pollution and incorporating bird-safe development. This development emphasizes making glass visible to birds. Research concludes that songbirds need a visual barrier every 2 inches horizontal and 4 inches vertical to prevent colliding with the glass. The only exception being hummingbirds that need a visual barrier every 2 inches by 2 inches due to their small body size. There are numerous methods to reduce collisions from temporary solutions of tempera paint to soapy water. Permanent solutions include bird-safe film, BirdSavers ©, ABC Bird Tape ©, and even bird-safe glass for new development.

In 2015, U.S. Fish and Wildlife Services Patuxent Research Refuge reached out to LOB to reduce collisions at the visitor's center and make the center a model of conservation. The visitor's center comprised of 7 large glass windows and 4 doors on the front that reflected the outside environment (Photo 1). The back of the center also included one large glass wall and several small classroom windows that faced the refuge's pond area and directly across from bird feeders positioned about 10 feet away. The abundance of glass on the center situated in the middle of a wildlife oasis made it a hot spot for bird collisions. An average of 132 birds died per year from colliding with the front windows and the back of the center averaged 58 deaths annually. The first and only step in achieving a bird-safe building for Patuxent is adding visual barriers to the center. Thus, began the process of deciding what retrofit treatments to install, working budget, fundraising and permission that would be needed to change the exterior of a federal building.

The treatments for the back surface of the center were easy to choose and budget for. First was the large glass wall that faces the beautiful refuge to focus on. The view from the inside looking out onto the lake needed to be maintained, so a white CollidEscape© was installed on the exterior of that glass wall (Photo 2). The CollidEscape presents a clear image from the inside while creating a barrier for birds on the exterior. The next step was to install a product on the several classrooms lining the back of the center. For this retrofit, BirdSavers, a simple black paracord was added to each window (Photo 3). This retrofit was simple and inexpensive to install. After retrofitting, the back of the center, we worked with Patuxent to discuss how to retrofit the front of the center. This installation needed to be visually attractive, since it is first view for the public. We knew that the cost for this project would be more expensive and time consuming.

Jennie McNicoll, Patuxent Visitor Services Chief, our collaborator at the center with this project wanted the front windows to tell the story of the local wildlife. LOB Outreach Coordinator, Lynne Parks is a local artist whom focuses her art on bird conservation, so Lynne was brought into the conversation to design the 7 front windows and 4 doors with Jennie's desired vision. Lynne chose to focus each window on local fauna. Thus, came the lovely design of a different flora or fauna on each glass panel. The panels would represent species individually as a cut out silhouette in the film. The project was too intensive for one artist, so another local artist, Chris Siron was brought in to design 3 panels, while Lynne focused on the other 4 and doors. After designs were complete, they were priced out at a local printing companies for cost comparisons. Without a huge working budget, we began fundraising to pay for the printing and installation of the film.

In 2016, I won the AAZK Conservation, Preservation, and Restoration (CPR) grant that funded the costs of the retrofit. The panel and door designs were printed on a blue perforated film in full sheets for each panel or door. Printing the design on a full sheet allowed for a clear view from the inside (Photo 4). Then a clear transparent film was placed on top of the perforated film to protect and ensure the longevity of the film. From conversation to installation the process took over 2 years resulting in a beautiful landscape of wildlife as you enter the center (Photo 5).

Daily monitoring of both the back and front of the visitor's center for fall 2017 and spring 2018 for a full year of data proved that bird collisions drastically decreased. The back of the center had a complete deduction from 58 deaths to 0. The front of the center decreased from an average of 132 to only 2 deaths within the year. In addition to the retrofits, both LOB and Patuxent wanted the center to inspire visitors to take an initiative at their own homes. An education kiosk was added in the center with signage to explain the center's installations, provide samples of the products used in the installations, and literature provided by LOB and American Bird Conservancy to bring awareness to bird collisions.

Awareness is the first step in conservation. Dr. Daniel Klem, world's leading expert on collisions, states that "you would need 333 Exxon Valdez oil spills each year to match the carnage," of the lowest estimate of 100 million deaths by collisions. This simple reasoning is that daily collisions do not garner the media attention that a massive oil spill can. With the AAZK CPR grant funded installations and educational kiosk at Patuxent Research Refuge visitor's center, Patuxent and LOB were able to directly conserve migratory birds, bring collisions to the forefront, and inspire visitors to do the same.

**Acknowledgements**

AAZK Grants Committee, Jennie McNicoll, Lynne Parks, and Chris Siron

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ABC Tape© https://www.collidescape.org/abc-birdtape

BirdSavers© https://www.BirdSavers.com/

CollidEscape© https://www.collidescape.org/

Captions for Photos:

Photo 1: Reflection of the environment is deadly to birds.

Photo 2: Back of the center with white CollidEscape installed.

Photo 3: BirdSavers installed on classroom windows.

Photo 4: Inside view of the installed film.

Photo 5: Final installation designs by Lynne Parks and Chris Siron.

**Saving the Saola: The role of zoos in saving from extinction**

**a species that no zoo holds.**

William Robichaud

Saola Working Group

2018

***From discovery to loss***

In 1992, what was perhaps the most spectacular zoological discovery of the 20th century was made in the Annamites Mountains of Vietnam. A survey team described for the first time a new genus and species of living bovid, the Saola (*Pseudorxy nghetinhensis*), and soon after it was confirmed to live in neighboring Laos, as well. Since then, other previously unknown animals continue to be described from the Annamites – in a pace of discovery of larger vertebrates unmatched by any other region in the world.

Unfortunately, a recent explosion in the Asian wildlife trade has put many of these species at risk of extinction, before we even know much about them. Saola is now one of most endangered terrestrial mammals in the world. Most threatened wildlife species in Southeast Asia are imperiled by targeted offtake for the wildlife trade, either for bushmeat or traditional East Asian medicine. Paradoxically, Saola is one of the only large animals in the region without a significant price on its head. Because the species does not occur in China, Saola does not appear in the traditional Chinese pharmacopeia. Saola are killed mainly as by-catch, largely through the intensive setting of wire leg hold snares. While tragic, this also presents a tremendous hope and opportunity for saving the Saola. Unlike rhinos and Tigers, poachers are not racing conservationists to find the last Saolas.

Under the aegis of the Saola Working Group (SWG) of the IUCN Species Survival Commission, an international consortium is being assembled to save Saola from extinction. The approach being applied is the IUCN "One Plan" – the pairing of *in situ* and *ex situ* conservation efforts into a single integrated program. As part of this effort, the world's first Saola conservation breeding center is on track to be opened in Vietnam within the next 12 months.

Perhaps surprisingly, although no zoo collection in the world holds a Saola, zoos have been critically important partners in the effort to save the Saola. This remarkable level of zoo and zoo staff involvement will become even more important as we progress toward holding Saolas under professionally managed captive care, for the first time since the species was discovered. Considerable challenges remain, but success is possible if we work together.

***The challenge ahead***

Without doubt, establishing a successful conservation breeding program for a species so little known, and with no captive founders in hand, is a significant challenge. Yet we lack the luxury of an easier option. Saola's rarity and elusiveness make precise population estimates difficult, but the SWG has concluded that there may be fewer than 100 Saolas left, and we are certain that the total population is not in the several hundreds. It is without doubt one of the world's most endangered large mammals.

The SWG and its partners have made substantial progress in improving protection in the Saola's range. In five protected areas in which the SWG and its partners have focused protection efforts, since 2011 rangers have removed close to 200,000 wire snares from the forest. The *in situ* protection effort also benefit, of course, many other forest-dwelling species, such as Owston's Civet (*Chrotogale*

*owstoni*; IUCN Red List Endangered) and Large-antlered Muntjac (*Muntiacus vuquangensis;* IUCN Red List Critically Endangered). Nonetheless, while progress on the ground has slowed Saola's slide toward extinction, it has not halted it. Nowhere in the species' range is any Saola subpopulation yet secure from poaching. And even if all poaching could be stopped today, the effects of small population sizes would still imperil the last wild Saolas, and likely soon propel the species to extinction.

That said, a successful conservation breeding program is not just about captive management - wild places need to be secured into which to release the captive-bred progeny. This dual effort, coordinated as one program, is the One Plan, and is the approach being taken for Saola by the SWG.

***Navigating risk***

A Saola conservation breeding program carries significant risk: animals could die during capture or confinement, they may not breed, and there could be a public relations backlash if the effort does not succeed. We are attempting to keep, and breed, a genus of large mammal that has never been successfully kept before. However, not attempting this now, choosing to not act, would pose a far higher risk to the survival of this beautiful animal.

Time has run out for Baiji (*Lipotes vexillifer*) and for Kouprey (*Bos sauveli*) – not because action was taken, but because action wasn't taken soon enough. We have a chance to do something different for Saola, which will entail embracing the conservation breeding challenge rather than shying from it.

***A partnership for success***

The challenges and the risks dictate that a Saola conservation breeding program must be done to the highest standards of international best practice, and be

sufficiently funded. For this, the SWG has assembled an international consortium and partnership to save the Saola. Zoos and zoo staff play key role in this partnership. Zoos are some of the most important donors to the project, and in the past several years the SWG has added several zoo staff to its membership.

In early 2017, a decision was reached to establish the conservation breeding centre at Vietnam's Bach Ma National Park, where the government of Vietnam has since allocated to the SWG about 40 ha of land in the park's administration zone. Both the SWG and the Vietnamese government have decided and agreed that the centre should add value by also initiating the world's first conservation breeding program for Large-antlered Muntjac, another Annamites endemic under similarly high threat from poaching.

Working together, in partnership with the governments of Vietnam and Laos, and zoos of the world, we are giving Saola and Large-antlered Muntjac their best hopes for survival. While the path ahead will not be easy, we know that with deep collaboration and unwavering commitment, success is possible. And we at least owe Saola that chance.

# Desert Dwelling Giraffes of Namibia

Michael Bona, Animal Keeper
Los Angeles Zoo and Botanical Gardens

Giraffe populations have declined by 40% over the past 30 years. With fewer than 100,000 individuals left, they are suffering what has been referred to as a "silent extinction". I have been involved with the Giraffe Conservation Foundation (GCF) since 2010 when I met co-founder and executive director Julian Fennessy at a conference for Giraffe care professionals at the Phoenix Zoo. Hearing Julian talk about the plight of giraffes in the wild and their need for conservation motivated me to get more involved. Later that year I was in Kenya participating with the GCF and the Rothschild Giraffe Project. I have also been heavily involved with fund raising for GCF through the Los Angeles AAZK Chapter. Since the first World Giraffe Day in 2013, I have hosted jeans donation drive and restaurant fund raisers, but nothing has been as successful as our annual Laughs for Giraffe comedy fundraiser. Our 3rd and most recent Laughs for Giraffes event this year raised over ten thousand dollars for GCF.

Last September, thanks to a grant for advance keeper studies from Los Angeles Zoo Trustee Dominic Ornato, I was provided the opportunity to work with the GCF again in Africa. This time I traveled to Namibia to work with Angolan Giraffes in the North Western Namib Deserts. This conservation initiative is the first long-term ecological monitoring effort on the desert-dwelling Angolan giraffe in northwestern Namibia. The program collects, collates and disseminates information – both popular and scientific. This information is useful locally and internationally for government, NGOs, communal conservancies and other interested partners to help with the conservation and management of Angolan giraffe.

The Angolan giraffe is a subspecies of the Southern Giraffe. A couple years ago the GCF published genetic research that shows that there are four distinct species of giraffe. Before this they have been categorized as 1 species divided into 9 subspecies. The Angolan population is estimated to be around 13,050 individuals. These giraffes have adapted well to this harsh desert environment. However, this ecosystem is fragile and easily disrupted. Grazing for cattle and other livestock, increasing tourism in the region and historically poaching has been an issue as well and this has led to some degradation of the environment and its wildlife.

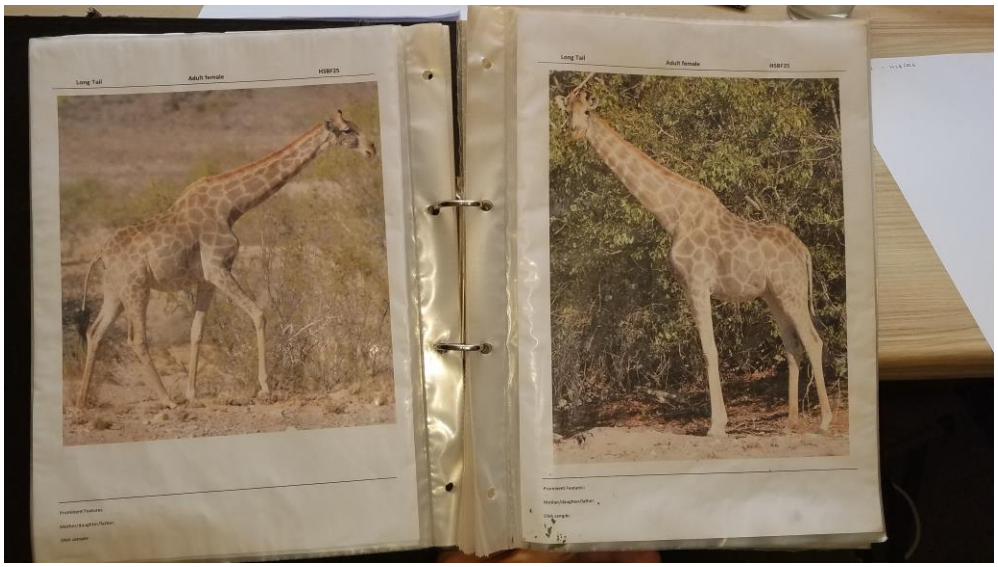
The Namib Desert is the oldest desert in the world. I was in awe of its beauty and surprised how animals such as giraffes, rhino, elephants, kudu, and zebra can survive in a virtually barren environment that received less than 50mm of rainfall every year. Survival in this desert depends on the foliage that grows in the riverbeds. These rivers are dry for all but 2 weeks of the year, when rainfall north of the desert fills the rivers and it's the underground water storage that keeps these plants that the animals feed on alive throughout the year.

For this project, our task were to take a census of all giraffes we spotted, obtain DNA samples from as many giraffes as possible, and to attached GPS trackers to 7 giraffes to track their location year round. These goals were accomplished with help from keepers from Como Park Zoo, Twycross Zoo in the UK and the Taronga Western Plains Zoo in Australia as well as Julian Fennessy and Emma Hart from GCF, Dr. Pete Morkel (our Veterinarian) and conservationist Ivan Carter.

CENSUS:

Several days of the two weeks spent on this project involved taking a census of all the giraffes and groups that we could find. We explored the Hoanib and Hoarusib Rivers and any and all areas in between for giraffe. The Giraffes tend to congregate close to the riverbeds, which made them easier to find, as opposed to lusher savannah like settings in other countries you may find giraffe in. The river beds are the life line of this arid environment. Once a group or individual was located, we would record the number of individuals, their GPS location, and their behavior. If giraffes were browsing, we would take note of what type of tree they were browsing on. . In order to accurately identify these individuals from both past and future research, photographs were taken of the right and left side of each individual. Information about each giraffe was logged, including location, herd members, age, and sex, the latter categorized into four groups: new born, juvenile (less than 1 year), sub-adult (1 – 5 years) and adult (5 years and older).

During the 10 days we spent out in the field, we were able to identify 145 individuals. There are approximately 300 giraffes known to inhabit this research area of approximately 4,470 square miles. Most of these giraffes have been catalogued and identified by their spot patterns. When a giraffe is spotted that hasn't previously been observed by a researcher, it is added to the catalogue. This information will allow us to continue following these individual giraffe and see where they travel and who they interact with over time.




Giraffe identification catalogue

DNA SAMPLES:

One of our tasks was to collect DNA samples from giraffes in this region. This involved locating a giraffe and identifying it in the field to make sure its DNA has not already been previously collected. If not, the giraffe wold be darted using a specialized dart that grabs onto a small amount of tissue sample from the giraffe's skin. Sort of like a punch biopsy. The dart would immediately pop out and fall to the ground for the researches to retrieve.

The samples are sent to the GCF's partners at the Senckenberg Institute in Frankfurt, where researchers are working on assembling a genetic pedigree of the entire giraffe population in this area. With this information they will be able to determine the relationships between each of the giraffes. This data will be useful towards gaining a better understanding of giraffe social networks.

With a complete understanding of the genetic relationships of each individual in this region, we would have a great understanding of who is related to who. We would be able to tell offspring's and relationships with other individuals in the group and have greater knowledge of how these giraffes socialize and move in and out throughout different groups. So far, GCF has obtained DNA samples from approximately 1/3 of the population In this area.

Tissue sample to be sent for DNA analysis

GPS:

This part of the trip was a real highlight for me. During our 10 days we fitted GPS (global positioning system) monitors on seven giraffes in this region. GPS data allows GCF to track giraffes and analyze their patterns of movement. Over the years, the tracking devices used on giraffes have evolved from a box attached to massive straps that were wrapped around the animal's shoulders and back. Then the unit's became smaller and were strapped around the giraffe's head, which were still cumbersome and would rub against the animals' skin. On this expedition, we were thrilled to be using the latest in GPS technology, solar-powered GPS units. These units are about the size of a cell phone and are able to attach to one of the giraffe's ossicones (the horns

found on the top of a giraffes head. They are bone covered with skin and hair and differ from horns and antlers).

On this trip we placed monitors on 7 individuals, 4 males, and 3 females. Finding the right candidate for a giraffe to receive a GPS monitor is the first priority. We are looking for an individual who is not too young or too old. We want to avoid any nursing mothers and any males that are too large and may put up more of a fight than we are prepared to handle. Location is also important. We don't want to dart a giraffe that could potentially run to an area we can't follow, or to an area where it could injure itself. Once we pick out the perfect candidate for a GPS unit, then we can dart.

I had the privilege of working with Dr. Pete Morkel, who is a world renowned wildlife veterinarian. He works in several different African countries and it was a pleasure and a great learning experience to have him helping us on this expedition.

Dr. Morkel loads his dart with a mixture of Etorphine and Hyaluronidase. After the giraffes is darted, the team follows close by in our vehicles. In most cases, the sedative given is sufficient for the giraffe to go down on its own. However, in a few instances, the team had to intervene to help the animal to the ground. When the sedatives start to take effect, often they will start to run. At this point we drive our vehicle past the animal in attempt to position ourselves in its running path. When we are in a good position the team will jump out of the pack of the pickups, stretch out a rope in the animal's path and wrapping it around its legs. Once the giraffe makes contact with the rope, we run to keep pace with the giraffe and we cross both ends of the rope around the back legs of the giraffe to wrap it up. All while trying to keep pace with the giraffes and not crash into each other as we cross the ropes. If this fails to bring down the giraffe then we all jump back into the truck and try again. This may sound dangerous, but only because it is. Our team trained for this before sedating our first giraffe and even though it process did not work smoothly every time I am pleased to say that all seven giraffes went down without sustaining any injuries. Every time the team immobilizes a giraffe, the animal's safety is the number one priority.

As soon as the giraffe hits the ground, a couple people will restrain it by sitting on its neck and covering the eyes. With the weight of two or three people on a giraffe's neck it is unable to obtain the leverage to get up. Once the giraffe is restrained, Dr. Morkel would inject the giraffe with a reversal drug to counteract the sedative. It's difficult to know the correct dosage of sedative to give a giraffe as we do not know the exact weight, so they are giving a higher dose to compensate. As a result a reversal must be given right away to prevent the giraffe from overdosing. This means the giraffe is awake during the entire procedure. This is beneficial since if any issues occur during the procedure that could jeopardize the giraffe's health or safety, we can simply abort the mission and let the giraffe up to leave. The giraffe's welfare is always our number one concern.

The GPS unit is attached to one of the giraffe's ossicones. Two holes are drilled through the ossicone and the unit is bolted straight through. This helps to secure that the unit won't fall off. They have even been shown to stay in tacked on a bull as it fights with other males.

While the GPS unit is being attached, the other members of the team are working on retrieving measurements of the giraffe. We document the length of the giraffe's legs, tail, back, neck, ears, face, and ossicones. All this information is documented for future research.

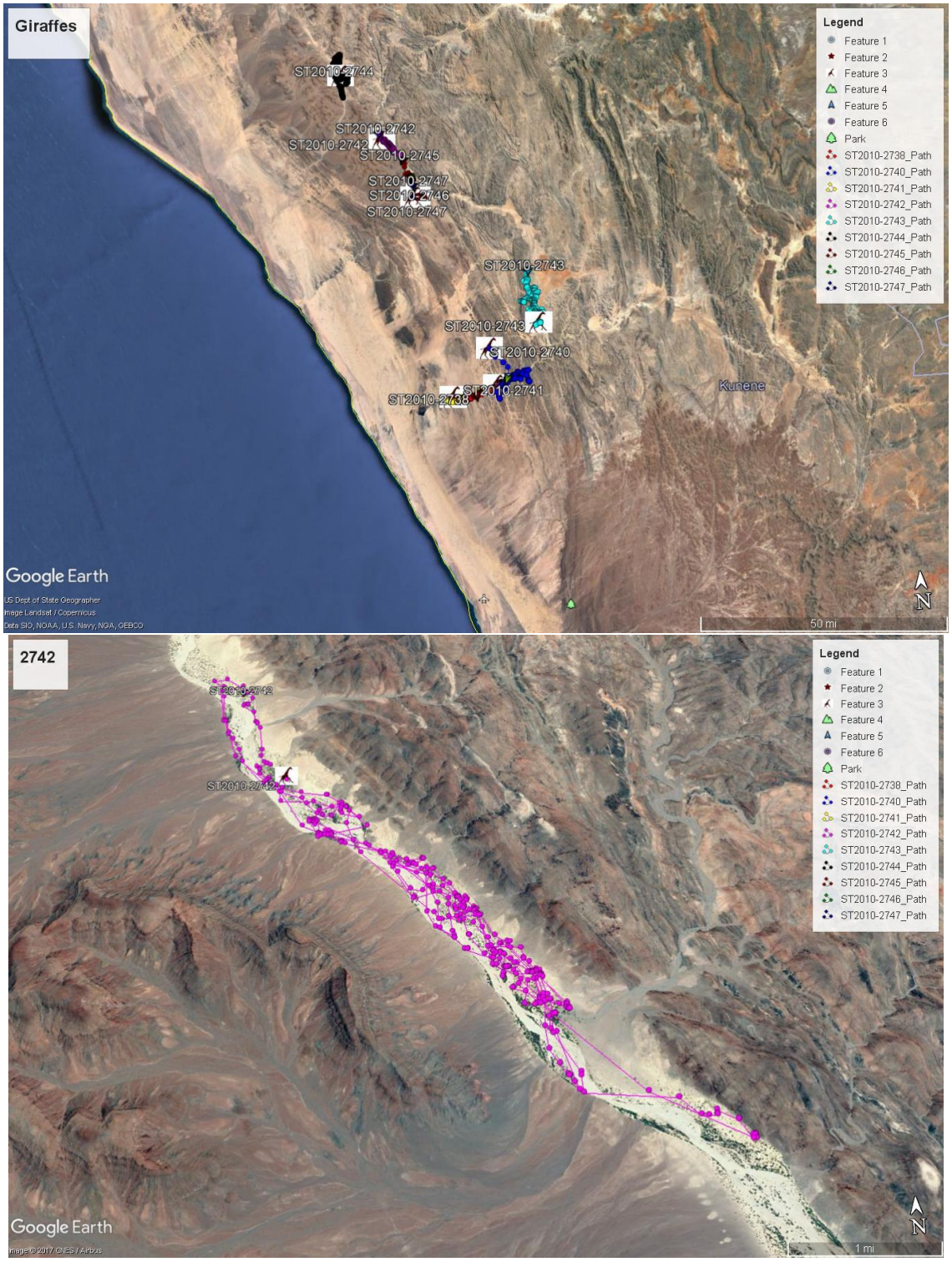
As soon as the GPS unit is properly mounted onto the ossicone, it is time to release the giraffe. We quickly dismount from the giraffe's neck and step back. The Giraffe will stand up and take off back into the wild.

The information collected from these GPS units will provide valuable insights into giraffe movement patterens and allow GCF researchers to analyze where giraffes move-daily, seasonally, and annually, and hopefully the reasons why they migrate to these locations. This key information will help to deepen our understanding of how giraffes use their environment in Namibia. It will also be interesting to see how the movement of these giraffes in the desert compares to giraffe populations in other parts of Africa, where there is typically a wider variety of food and water sources.

GPS solar pannel unit

Restraining giraffe for GPS unit placement.


GPS Unit attached to ossicones




Satellite monitoring picture of giraffe movement in the past 2 weeks

CONCLUSION:

Knowledge gained from field research is shared with local communities and used to develop conservation strategies. For the Angolan giraffe and the other species that inhabit this arid region, a question of growing concern is how climate change will affect future availability of food resources.

This trip not only gave me firsthand experience with field conservation but also allowed me to meed and work with some amazing people such as Julian Fennessy, Dr. Pete Morkel and Ivan Carter as well as other zookeepers from around the world. This was certainly the adventure of a lifetime for me, and I hope to return again soon to do what I can to help prevent these magnificent giants from going “silently” extinct.


Whenever we do any activity, eat food, go outside- anything, we are affecting our well-being, and that of the planet. This begs a question- If everything we do affects our health and impacts the earth, why haven't we bridged the two concepts, ensuring what we do is good for us, and good for the environment?

This is the essence of Conservation Fitness. Get people engaged in conservation and their well-being together. To show the world how conservation and wellness are interconnected.

For years, we have listened as conservationists exclaimed "reduce, reuse, recycle", "drive less", and "eat organic/local food"
Simultaneously, fitness experts have been telling us to "eat less fast food", "exercise more", "eat whole, unprocessed foods"
Both parties are telling us the exact same thing, just in different ways.
Conservation Fitness creates the bridge between the two and show how we can achieve BOTH.

If you are a keeper who does keeper chats, presentations, and interactive programs, this is great news for you. What I'm going to share with you today can make a bigger impact on your conservation message. Your audience will not just learn how to take care of the earth, they will be more motivated to do so weeks, even months after they leave your zoo.

Connecting visitors to the animals is one of the most important tools we have as zookeepers. Without the emotional connection, it isn't as easy to convey information. Our animals make it easier to want to do something.

Unfortunately, in today's world, it takes more than WANTING to do something to bring about actual behavior change. There is a lot of research showing the key to motivation and behavior change is drawing a direct line from effort to success. The more direct the line, the more successful you will be.

Animal Trainers understand this notion. It's why we use a bridge- it draws a direct line from the effort of the behavior to the success of receiving reinforcement. If the animal doesn't receive some sort of acknowledgement for a long time (at least in the beginning of learning a behavior), they are more likely to get frustrated and give up. Humans are no different. Without that direct link between doing a behavior and seeing results, even the most motivated can falter.
How do we connect the bridge for our visitors? How do we do it ourselves?

We make conservation action personal. When we make it personal, we ask our visitors to take action, but give them an extra incentive. Show them how they will directly benefit from our suggestions. While conservation is inspiring, it is difficult to gage our success when the action occurs in a far-away land. And unfortunately, out of sight, out of mind. When we connect visitors using Conservation Fitness, we demonstrate how these actions save animals, but our visitors get something out of it, too. These actions affect US. They improve OUR health, help us lose weight, get in better shape.

Conservation Fitness works by creating bright lines in developing healthy habits. These bright lines make it difficult to negotiate, but easy to commit. Think of statements such as “I do not smoke”, “I always brush my teeth before I go to bed”, “I do at least 30 minutes of art every single day”. These statements are absolutes.

What makes Conservation Fitness unique is we take these bright lines, these non-negotiable statements, and use them to EMPOWER us to commit to our healthy habits by way of conservation. Even when we have drawn bright lines and committed to a certain way of life, a small part of our brain wants to continue negotiating. When donuts are in the breakroom, “I do not eat donuts” is suddenly not so much a bright line as a squiggly penciled line with an eraser. The devil on our shoulder tells us “but we worked out. Didn’t we EARN a donut?” Psychologists call this part of our brain the Saboteur.
The Saboteur is a result of depleted willpower. We have only a finite amount of willpower, and creating new habits uses willpower to strengthen the behavior, in the beginning. Conservation Fitness provides everyone with a sort of bouncer to Club Brain. It kicks the Saboteur out by boosting our willpower with a connection to something outside ourselves- the preservation of our favorite animals.
Our animals play a key role in this process. I call them our Willpower Animals. Because with conservation on the line, eating a donut is out of the question. It’s not just about you, it’s a direct line to conservation. By choosing the healthier option, I am doing my part to conserve a species.

The main two pillars of Conservation Fitness are Eating Green and Experience Nature. Ironically, these also happen to be the core components fitness experts focus on as well- nutrition and exercise. Eating Green and Experiencing Nature have a lot for us to share with the community about getting healthy and achieving our fitness goals, all while having a positive impact on the planet

Eating Green-
Many of us have heard of eating clean. It’s a common fitness term. Eating green takes this concept one step further and develops healthy habits to promote sustainability.

Palm oil is a prime example. We know palm oil can have devastating effects on orangutans, rhinos, hornbills, and countless other species. But did you know most of the palm oil we consume can have devastating effects on our health?

The number one recommendation from nutritionists and fitness experts for better eating habits is to eliminate processed foods.
What is the one ingredient which nearly all processed foods have in common? Nope, not sugar. It’s palm oil.
Now I know the general consensus from zoos is not to boycott palm oil completely. The best option is sustainability.
But to be honest, when it comes to your health and well-being, eliminating it from our diet is the best solution.

When we say no to palm oil in our foods, we are sticking it to big food companies who try to manipulate us into eating junk "food like substance" instead of real food.
Using the Eating Green principle, instead of justifying eating the cookies we have sworn off, we say no with conviction. We don't feel resentment for missing out on the treats, we feel empowered.
We are eating green. It's not just the bright line of I don't eat processed food. It's the connection to conservation. "I don't eat food with palm oil in it." This statement empowers us to do what is healthier for us, and better for the planet.

How do you incorporate the concepts of Eating Green into your talks to share with visitors? Believe it or not, Eating Green was actually developed as a talking point for my keeper chats, about palm oil specifically. As an elephant keeper, I introduced my audience to Bamboo and Chai, two Asian elephants at Woodland Park Zoo. They were amazing and could easily win over any audience, as I'm sure many of you are aware our animals do all the time. I hooked my audience with special stories of the girls, and showed off special skills. But when I tried to convey the urgency of protecting elephants, I still tended to lose some of my audience members. With Eating Green, I was able to convince visitors to listen further and change their behavior. By making it about them. I asked "How many of you would like to eat or be healthier?" Everyone quizzically raised their hand. "What if I told you by eating right and taking care of yourself could also save elephants?" After that, sharing about palm oil and reading labels of our food packages was not just preaching them to care only about Asian animals, I gave them a personal reason to be on the lookout for this potentially harmful ingredient.

Nowadays, I give nutrition seminars and tell my clients the same thing- "When you eat healthy, you are saving orangutans." Later they tell me stories of grocery shopping and being tempted to get the processed cookies or ice cream. But they recall the points in my talk, and feel good about walking away. I have them choose their own willpower animals, it doesn't have to be elephants or orangutans. One of my clients uses tigers to help her fight temptation from eating foods with palm oil in it. What's more, they also tell me the results from eliminating palm oil helped them lose weight (which was their goal). It was a direct link between effort and success, and they felt great about both actions- conservation and eating healthy.

We can also make this connection for just about any habit, and just about any animal or ecosystem represented in zoos and aquariums.

Teach your guests to eat out at fast food restaurants less and reduce the devastation of deforestation. Instead of going out to eat, or grabbing a to-go lunch somewhere, save money and the environment while trimming your waistline. Prepare your meals at home, ahead of time, and make the healthier option easy and convenient. When we eat less fast food, we reduce paper waste

We also reduce waste from single-use plastics. How many have seen the video with the sea turtle getting a plastic straw removed from its nose? That sea turtle became an unspoken mascot for eliminating single use plastics. But it doesn't have to be sea turtles, it can be golden

lion tamarins, clouded leopards, pandas, salamanders. In fact, the true inspiration for Eating Green concept of Meal Prepping came from the Chopsticks for Salamanders campaign. Feel good about eating home-prepped foods because you are making a difference in conservation.

Connect your visitors with the action of drinking coffee or tea in the morning with saving sloths in the rainforests. Share how drinking shade grown teas and coffee promote old growth rainforests. These shade grown beverages aren't just more delicious, they are packed with healthier benefits than regular plantation grown teas and coffee.

In the Pacific Northwest, many people were moved to action by the behavior of a local orca pod. J-35 seemed to be grieving as she carried her deceased calf with her for weeks. The outrage brought thousands of activists to protest the non-sustainable fishing of chinook salmon. The community spoke out not just with their voices, but with their dollars. They demanded the fish they ate were sustainably caught, ensuring the healthy omega-three fatty acids in their meals were helping their oceanic neighbors.

The possibilities are quite endless. I could spend all day talking about how Eating Green can benefit our fitness and the environment. But let's move onto another facet of Conservation Fitness, Experiencing Nature.

Experiencing Nature is all about the direct connection between our fitness and the earth. Studies show that exercise is like taking a little bit of Ritalin and a little bit of Prozac. It helps focus our attention, gives us energy, and improves our mood.
Here's the thing. Being outdoors while you exercise has shown researchers it actually AMPLIFIES the benefits twofold. So, being outdoors and exercising is excellent for our health. But how does it benefit the environment?

How many of you work with animals affected by climate change? How many of you discuss climate change in your talks or programs?
There are a dozen ways to help combat climate change, but my favorite method is doing something which actually benefits me, too.
Biking has a profound effect on our cardiovascular fitness. It saves money. And it just so happens to decrease our carbon footprint, quite significantly.
In a thirty minute bike ride, the average person burns 350 calories. It's highly recommended as a low impact, high intensity exercise. And in a research study, by changing absolutely nothing else (such as diet and workout program), participants lost 13 pounds in a year by riding their bike.
Maintaining a bike costs twenty times less than a car.
And, finally, if one out of every ten commuters in the US switched to biking, it would save 2 BILLION gallons of gas every year.
It doesn't matter what animal you work with. Everyone is affected by climate change, including humans. By convincing your guests to work out a little more, they will help the environment significantly and improve their well-being. It does our body good, and does a world of good too.

Recycling is one of the most wide-spread ideals for educating our visitors. But I found through fifteen years of trial and error, you are a lot more likely to get people to pick up trash if I tell them it will help them lose weight than if I say it is healthy for the environment alone. And I discovered a way to teach clients and fitness enthusiasts to not just reduce their trash. I taught them a Zookeeper Principle, what I call the Macgyver Principle. Can't recycle something? Don't throw it away, it might make great enrichment. If we can do it with our animals, why can't we teach our guests to find creative crafts for their non-recyclable trash. By turning household items into workout equipment, we reduce our waste, while reducing our waist.

A final connection for Experiencing Nature and Conservation Fitness applies to every single one of your zoo visitors. As I said before, getting our exercise outdoors amplifies our health benefits. It's the absolute best way to obtain our vitamin D, which helps fight depression, maintains bone strength, and boosts our immunity. Being outdoors also activates certain parts of our brain which can both relax us and stimulate us. So, I praise zoo-goers for not just supporting their zoo and the conservation projects, I congratulate them for taking care of themselves.
I encourage people to find a special "sacred" place to call their own. It can be a secluded spot in the woods, a park, or an animal exhibit at a nature center or zoo. Go there as often as possible. It sparks what I call passive conservation, or conservation through osmosis. The more you love a place, the more we are willing to do whatever it takes to protect it.
Zoos are mentally stimulating, educating, relaxing, and healthy ways to recharge, connect to nature, and support great conservation throughout the world.

There are dozens of ways to connect to the earth in healthy ways, all at your zoos. Discover what methods appeal to you by practicing Conservation Fitness, and pass on the healthy lifestyle to your community. And see how you can achieve successful fitness through wildlife conservation.

Thanks you! And Eat Clean, Live Green, Train Positive

# Goodbye African Sacred Ibis- Hello Madagascar Sacred Ibis!

## How *Strategic Planning* is changing the animals we exhibit

By *Samantha Derman, Lead Bird Keeper, African sacred ibis studbook keeper and SSP Coordinator*

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Abstract

Since 1981, AZA zoos have been more conservation-oriented by being part of Species Survival Plans®. However, a 2009 assessment by AZA determined that of the more than 500 managed SSP's, few programs were estimated to be genetically and demographically sustainable over 100 years (SSP Population Sustainability). In other words, regional collection plans, studbooks, breeding and transfer plans and SSP sustainability reports alone are not doing enough to keep these programs healthy and viable. In 2015 AZA's WCMC launched a new initiative to help guide TAGs toward sustainability through strategic planning (Silver 2017). With the use of a new population tool called Population Viability Analysis, TAGs are starting to develop S.M.A.R.T. goals to help illuminate which programs need more space, need reproductive help or need to be ended. While this type of planning is valuable for maintaining healthy captive populations, due to the finite amount of space and resources that zoos have, it can come at the cost of ending the exhibition of certain animals. This is a case-study of how the African sacred ibis (*Threskiornis aethiopicus*) may lose its place in zoos to make way for more endangered species of ibis.

Introduction

In 2013 I was initiated into the world of population management when I applied for and was accepted as the African sacred ibis studbook keeper. The species had been held in captivity since the Twenty-Sixth Egyptian Dynasty (664-525 BC), but yet the population had been totally unmanaged (Bailleul-LeSeur 2012). It took about three years to publish the African sacred ibis North American Regional Studbook Report and to develop a Breeding and Transfer Plan. What we learned was that the population had zero known pedigree due to lack of management and it was a yellow program (Derman, Putnam 2016) (Table 1).

**Table 1. Applying Sustainability Criteria to Designate Animal Program Management Levels**

| Criterion | Green SSP Program | Yellow SSP Program | Red SSP Program | Candidate Program |
|---|---|---|---|---|
| Population size | 50 and above | 50 and above | 20-49 | 19 and fewer |
| # AZA member institutions | 3 and above | 3 and above | 3 and above | 2 or fewer |
| Projected gene diversity | 90.0% or above | Less than 90.0% | Less than 90.0% | NA |

Source: AZA SSP Handbook, 2014

We then made recommendations to institutional representatives for African sacred ibis to ensure a better pedigree for the future. It included making sure we can individually identify birds (better banding, transponders), sexing birds

of unknown gender, recording parents of offspring and creating single-sex flocks for surplus animals. We also recommended 30 hatches over two years in order to maintain a healthy growth rate toward the Regional Collection Plan's target of 175 individuals (RCP 2014). At the same time as these recommendations were being made, it was becoming more difficult to find spaces for African sacred ibis that weren't being taken by animals that occupied the same zoological niche like hadada ibis (*Bostrychia hagedash*), southern bald ibis (Geronticus calvus) and Madagascan crested ibis (*Lophotibis cristata*).The reasons appeared to be many, including that African sacred ibis breeding is notoriously difficult to monitor due to their prolific and colonial nature. Furthermore, critically endangered ibis like the waldrapp ibis (*Geronticus eremita)* were becoming more attractive to curators and directors at zoos for the conservation messaging that zoos were gearing towards; meanwhile African sacred ibis are Least Concern (IUCN 2018). As a program leader it was becoming apparent that convincing institutions to dedicate the time, resources and space for a difficult to manage and least concern animal was becoming a difficult argument to make.

Then I got a call from the Ciconiiformes and Phoenicopteriformes TAG chair, Harrison Edell, that would change the course of my program. He asked if I would be able to participate in a *strategic planning* meeting at the AZA mid-year meeting in Albuquerque New Mexico in March of 2017. He deftly explained that programs like African sacred ibis are taking up valuable spaces in zoos that could be occupied by more endangered birds and that this meeting would bring together everyone from the TAG in order to rectify these unsustainable practices. Harrison warned me that the African sacred ibis program I had just worked so hard to organize may need to be dissolved in order to make room for Madagascar sacred ibis (*Threskiornis bernieri),* which are identical to African sacred ibis morphologically, but have a conservation concern in that they are listed as Endangered by the IUCN (IUCN 2018). In the same breath he then asked if I would take over the program if it were to be started in North America since currently the only birds in captivity were in Europe. Without hesitation I said yes; I became a zookeeper because I wanted to make a difference in the life of endangered animals and this was my opportunity. A few months later I was in Albuquerque attending the AZA Mid-year meeting and learning more about population management than I had ever imagined.

## Materials and Methods

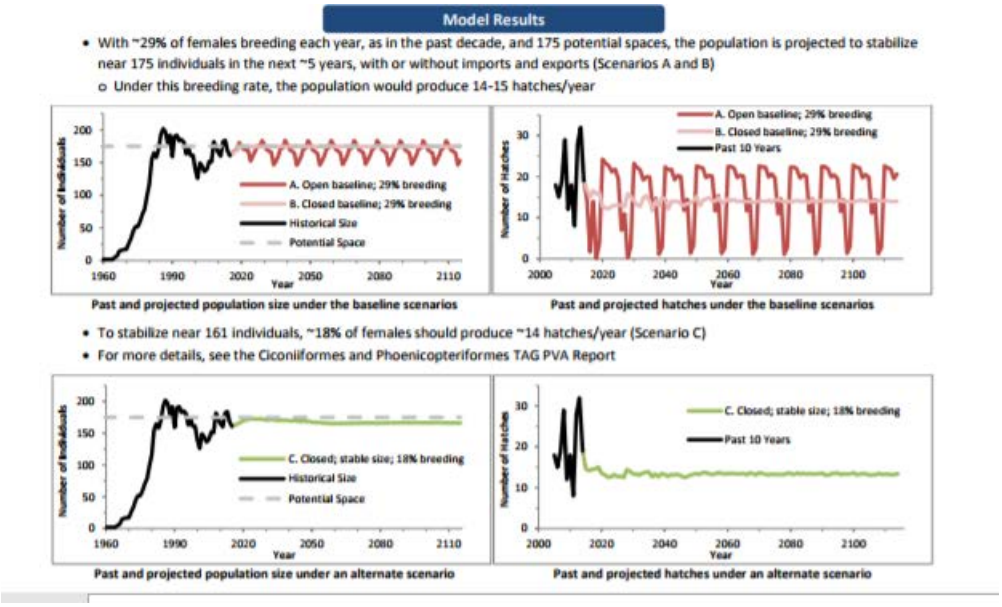
The 2017 AZA Mid-year conference in Albuquerque was host to only the third strategic planning meeting done by any TAG up to that point (Felid and Canid preceded). This meeting brought together various studbook keepers, SSP coordinators, curators, steering committee members, EAZA representatives and TAG chairs into one room for two days (one whole day at the beginning of the week-long conference, and another partial day at the end of the conference). Guided by the AZA's Wildlife Conservation and Management Committee, population biologists from the Population Management Center at Lincoln Park Zoo ran Population Viability Analysis on 19 different species within the Ciconiiformes and Phoenicopteriformes TAG. These species were chosen according to overlapping zoological niches, specific sustainability concerns and current IUCN and CITES statuses. No flamingos were analyzed in this meeting to due lack of sustainability concerns.

PVA's, along with Species Survival Plan® Sustainability Database, regional collection plans, population trends and other data were all tools utilized in this meeting. The room was open to other conference attendees to either observe or aid in discussion. The meeting at the beginning of the week was intended to go over each program's merits, the PMC's data and to direct the future of the TAG. The time in between was to allow the population biologists and TAG members to digest and organize the comments in order to come up with an action plan at the meeting at the end of the week.

## Results

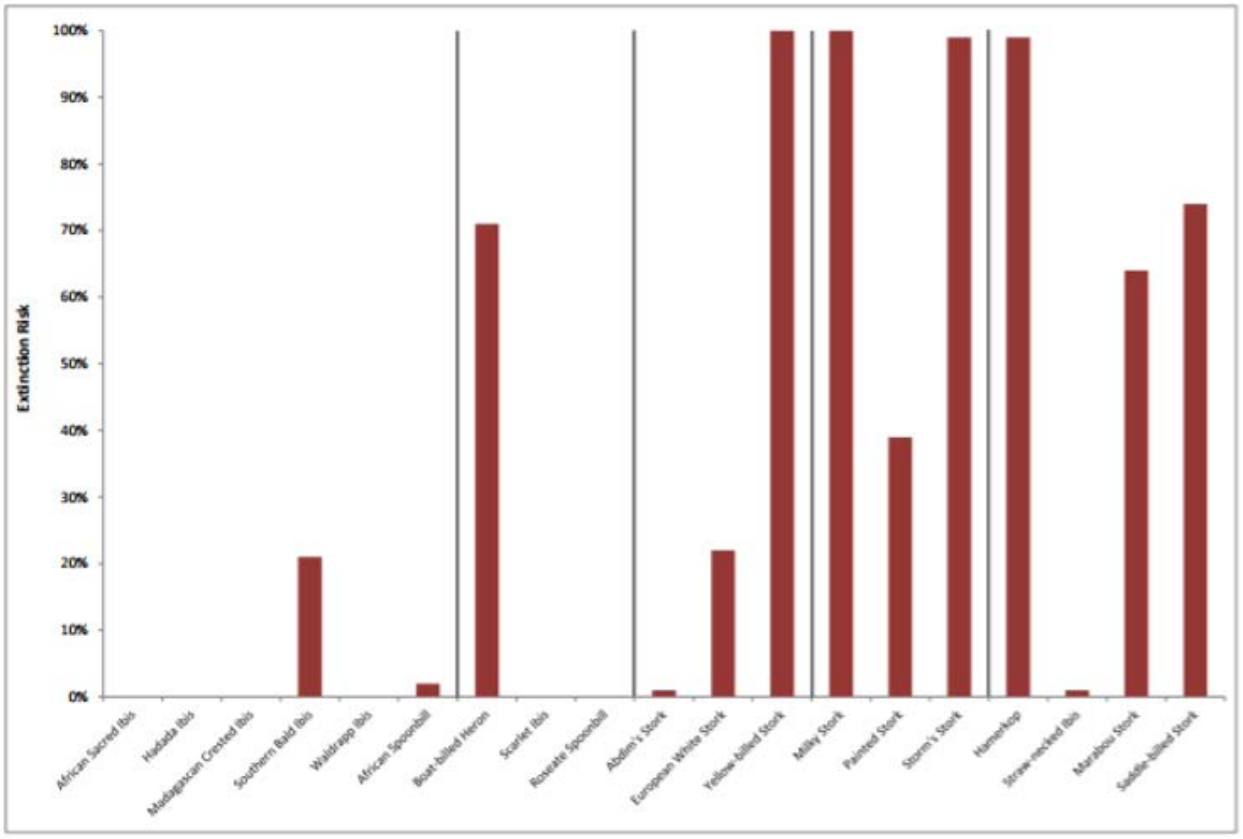
The Population Viability Analysis tool uses historical demographic genetic data to show hypothetic scenarios of what would happen to populations if we kept with current management or altered our management. In other words,

the data from the African sacred ibis studbook was used to project what would happen to the population if management were to continue the current growth or if management were to be altered (Graph 1). The conclusion for African sacred ibis was that was that the population would become demographically stable near 175 individuals (RCP target size) with fewer hatches per year than it produced during the last 10 years. Therefore, if growth were to continue as it has the last 10 years, the population has the potential to grow beyond the number of spaces available in zoos. Additionally, exports and imports wouldn't help the population, and would likely cause more variability in the population size from year to year.



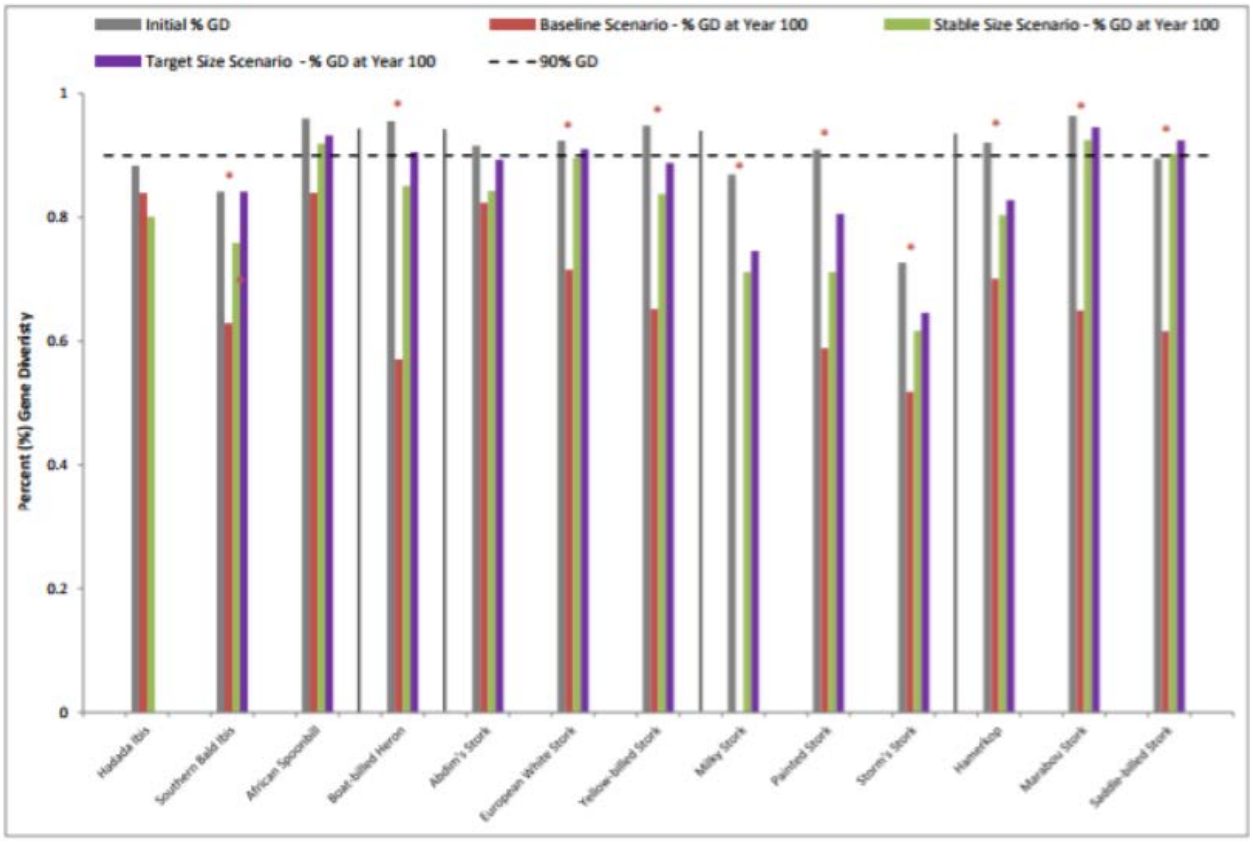

Graph 1. The first model shows how the population of African sacred ibis would fair with (red line scenario A) and without (pink line scenario B) exports and imports with current breeding rates. The second model shows the population stabilizing with fewer breeding females and a smaller target size of 161 individual spaces. Source: PVA Summary Report – 2017 African Sacred Ibis.

Next, comparative graphs between species that occupy similar zoological niches were provided by the population biologists. These graphs helped those in the meeting to see what the extinction risk would be for Ciconiiformes that occupy the same regional theming niche within zoos. African sacred ibis have a zero percent chance of going extinct, while southern bald ibis have a 20% chance. Boat billed herons have an almost 70% chance of extinction, while the very common roseate spoonbill and scarlet ibis have a zero percent chance. Even more stark, the European and Asian storks are all stealing resources and space from each other, causing all of their extinction risks to be very high. See Graph 2.




Graph 2. Probability of extinction for all AZA CInconiiformes Animal Programs under average breeding rates from the past 10 years (baseline management scenarios). Probability of extinction is calculated from the proportion of 1000 model iterations that decline to zero individuals within the next century. Source: PVA Summary Report - 2017 Ciconiiformes and Phoenicopteriformes TAG

Analysis of certain individual program's likelihood to make it to Green Status (more than 50 individuals in a population and 90% genetic diversity over 100 years) is very poor without changing management. Only five programs (saddle-billed stork, marabou stork, European white stork, boat-billed heron and African spoonbill) will reach green status in 100 years if we reach RCP target size. Of those five, all but one will have a more than 10% chance of extinction *ex situ;* therefore, if the population is extinct, what good is reaching genetic diversity? See Graph 3.




Graph 3. Starting gene diversity and mean projected gene diversity in model year 100 for AZA Ciconiiformes Animal Program baseline and alternate scenarios. Projected gene diversity is the mean of 1000 model iterations. The dotted line indicates 90% gene diversity. *These populations have a >10% risk of extinction in their baseline management scenarios. Source: PVA Summary Report - 2017 Ciconiiformes and Phoenicopteriformes TAG.

In all of these scenarios, it becomes apparent that resources are stretched very thin across the TAG and without reallocation we may lose the majority of these species.

## Conclusion

These results showed that most heron, hamerkop and stork populations are likely to decline in size without changing management strategies. Both spoonbill species are expected to decline as well, but only small increases in population will be needed to become more stable. It was also decided to reduce the target size for scarlet ibis (*Eudocimus ruber*) in order to allow more space for endangered species of ibis. In general, ibis populations would become stable under average breeding rates from the past 10 years.

The one clear conclusion that everyone seemed agree on was the fact that African sacred ibis are an easy switch to Madagascar sacred ibis. They look so similar, and with wild populations of Madagascar sacred ibis down to 2,000 in the wild (Andrianarimisa 2010) there is the potential that North American zoos could actually make a difference in this species. Assuming that breeding rates and husbandry are on par with African sacred ibis, it will take about 44 years to replace all *T. aethiopicus* with *T. bernieri.* See Table 2. Currently, there are no *T. bernieri* in North America, so AZA is exploring the feasibility of how to import birds without going through EAZA who currently has the exclusive export rights. We would also need to find funding to support *in situ* conservation efforts. In the meantime, it is important to maintain the population of African sacred ibis in order for those spaces to eventually be occupied by Madagascar sacred ibis.

| SCENARIO | | DEMOGRAPHICS | | | | | | | GENETICS | | | | OVERALL STATUS[2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Initial Size | Size in Year 25[1] | Size in Year 100[1] | Number of Spaces | Prob. of Reaching Space (%) | Prob. of Extinction (%) | Hatches/ Year in Next 10 Years | Initial GD (%) | GD Retained in Year 100[1] | Initial F | F in Year 100[1] | |
| **African Sacred Ibis** | | | | | | | | | | | | | |
| A | Open baseline; 29% breeding | 161 | 178 ± 5 | 153 ± 15 | 175 | 100 | 0 | 14 – 15 | - | - | - | - | Low Risk |
| B | Closed baseline; 29% breeding | 161 | 175 ± 5 | 175 ± 5 | 175 | 100 | 0 | 14 – 15 | - | - | - | - | Low Risk |
| C | Stable size; 18% breeding | 161 | 170 ± 9 | 166 ± 15 | 175 | 100 | 0 | 14 | - | - | - | - | Low Risk |
| D | 0% breeding | 161 | 29 ± 5 | 0 | 175 | 0 | 100 | 0 | - | - | - | - | Critical |
| **Madagascar Sacred Ibis** | | | | | | | | | | | | | |
| A | 10 imports; 29% breeding | 0 | 45 ± 29 | 174 ± 10 | 175 | 91 | 8 | 2 | - | - | - | - | - |
| B | 20 imports; 29% breeding | 0 | 102 ± 41 | 175 ± 5 | 175 | 100 | 0 | 4 – 5 | - | - | - | - | - |

*GD = gene diversity, F = inbreeding coefficient*

*[1] Mean value ± 1 Standard Deviation, taken across 1000 iterations. If an iteration goes extinct that value is not included in the calculation. Some results may only reflect a few iterations in scenarios with a high probability of extinction.*

*[2]ZooRisk uses five standardized tests to give a summary risk score for each scenario, from Low Risk (most secure), Vulnerable, Endangered, to Critical (least secure). For more details on this score, see the 'Ciconiiformes PVA Setup and Methods' supplemental document* on the AZA Ciconiiformes and Phoenicopteriformes TAG webpage.

Table 2. This table indicates how to safely reduce the African sacred ibis population without losing space for Madagascar sacred ibis. In order to prevent extinction of Madagascar sacred ibis, at least 20 pairs should be brought in. Assumes breeding rates will be on par with African sacred ibis.

Asian storks are at the biggest risk of extinction. They need more space to achieve larger population sizes. Storm storks in particular need imports to help with poor genetic variability. Furthermore, Milky storks and Painted storks are facing a similar scenario to the sacred ibis. Milky storks are more endangered and they look similar to painted storks which are not endangered, and yet they take up the same zoological niche. Another fact that came to light which could help with reproduction are that altered-wing storks seem to have a lower breeding rate than those that aren't altered. Finally, the meeting concluded that increasing breeding rates in the southern bald ibis, boat-billed heron, yellow-billed stork, hamerkop and marabou stork are needed.

The strategic planning meeting succeeded in that by getting all of the stake-holders in one room, critical, real-time discussion could be had about the viability of all of the animal programs in question. The process truly helped bridge the gap in understanding between the program leaders like myself, and the overall goal of the TAG, which is to create sustainable, healthy populations, but also to not deplete resources as programs compete for space amongst each other. In this way, the strategic planning meeting allowed for what would be a very abstract discussion to be laid out in a data and fact-driven way which made the tough decisions a little easier to make.

The results from the Ciconiiformes and Phoenicopteriformes strategic planning meeting allowed us to come with with S.M.A.R.T. (Specific, Measurable, Achievable, Relevant and Time-bound) goals going forward. These objectives are more tangible and measurable than anything we have had before, so if parameters change in the future we can adapt and change course more deftly.

Strategic planning is beginning to shape the future of the TAGs that utilize it and therefore the future of animal exhibition in zoos as we know it. Being part of the process can be a great career-developing opportunity for keepers who want to be a part of that change.

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# The role of institutional culture in determining quality of life, husbandry, and training of program animals

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**Abstract**

Lindsay Wildlife Experience (LWE) is a small ($2.5M annual budget) nonprofit organization housed in a 28,000-square foot facility combining a wildlife rehabilitation hospital with a public exhibit floor serving over 100,000 guests annually. In-house exhibits and outreach programs are supported by 70 wildlife ambassadors, comprising 48 species of non-releasable California wildlife. From 2012 to 2017, LWE experienced high-turnover in executive, veterinary and department-level leadership, with associated impacts to an institutional culture that was already siloed in departmental focus and hierarchical in its decision-making. Workplace culture is a significant factor in defining experiences of staff and volunteers, but how does it directly impact animal care? Two unexplored questions among animal care professionals are: 1) What role does institutional culture play in determining quality of life, husbandry, and training of program animals? and 2) Can significant strides in animal welfare be gained concomitant with an organization-wide intention to improve workplace culture? The objective of this presentation is to demonstrate how a supportive, inclusive "YES culture" encouraged keepers to expand their training acumen and engage in a collaborative, learning-rich environment, with the goal of improving the welfare and husbandry of program animals, despite limited resources. Using a 13-year old veteran golden eagle (Topaz) and a recently-acquired 13-year old bald eagle (Atsá) as case studies, we present challenges to keepers tasked with significantly increasing public appearances and on-site programming for both raptors, neither of which were trained for such activity. We discuss training techniques, goal-setting strategies, outcomes of each raptor's training regime, and present future plans for continuing to improve husbandry and training standards, under the framework of a workplace culture evolved to include and value keeper staff in all decisions related to programming, acquisition, educational interpretation, veterinary care, housing, exhibit design and welfare.

**Introduction**

Lindsay Wildlife Experience (LWE) is a small ($2.5M annual budget) nonprofit organization housed in a 28,000-square foot facility located in the San Francisco Bay Area. We combine one of the first wildlife rehabilitation hospitals in the United States with a public exhibit floor serving over 100,000 guests annually. In-house exhibits and outreach programs are supported by 70 wildlife ambassadors, comprising 48 species of non-releasable California wildlife. The Animal Encounters (AE) department manages its live collection with a staff of six, including one curator, three full-time keepers, and two part-time keepers, and relies upon volunteer support in completing daily husbandry tasks. Partnering with volunteers allows keeper staff to dedicate significant period of time to developing novel training behaviors and enrichment opportunities for on and off-site public programming. LWE's premiere public attraction is its iconic raptor collection, featuring 13 species of CA native owls, eagles, hawks, and falcons.

**Institutional Changes – Staffing and Culture**

Since 2012, LWE has experienced high-turnover in executive, veterinary, and department-level leadership, with associated impacts to workplace culture and strategic institutional focus. Additionally,

front-line department leadership resisted adopting progressive, contemporary best practices in conservation messaging, animal behavioral training, and/or enrichment over three decades. Following a significant rebranding effort in 2015, four institution-wide initiatives drove the need to re-evaluate LWE's animal program repertoire; these included: 1) expanding unique and exciting programming opportunities for guests; 2) maintaining a distinct institutional profile in an increasingly competitive niche market; 3) providing intellectually and physically stimulating behavioral training for animal ambassadors, and; 4) challenging keeper staff and volunteers to continually learn and hone new skills.

**Case Study – Golden Eagle, Topaz**

Background

Topaz is a female golden eagle (*Aguila chrysaetos*) that joined LWE's permanent collection in 2005 after being recovered near Topaz Lake, located on the California/Nevada border, with a left shoulder injury (i.e., scapula, coracoid, and humerus), rendering her flightless and therefore not a candidate for reintroduction to the wild. Estimated to be approximate 10 years of age at the time of her arrival, her case was medically challenging. Upon initial examination by LWE's veterinarian, it was discovered that, in addition to the damaged shoulder, Topaz presented with a high white blood cell count, anemia, ectoparasites, bumblefoot, severe shoulder arthritis, and clostridial enteritis, an anaerobic bacterial infection that produces toxins causing edema and hemorrhage, and occasionally mucosal dysfunction and necrosis (Pfau, 2009). The additive impact of Topaz's symptoms confounded recovery and required months of treatment, surgery and monitoring before her condition improved. Despite her medical challenges, Topaz's calm temperament permitted keepers to successfully man her to the glove, apply falconry equipment, and transport her from her outdoor aviary to the public exhibit hall. By 2007, Topaz was participating in weekly public presentations and remains a guest favorite.

For many years, Topaz's routine remained rigid and minimalist, even when relocated to an indoor enclosure in 2013-2014, where she became a more visible public presence. Despite keepers' request to elevate and accelerate novel behavioral, enrichment, and training opportunities for Topaz, proposals were met with either indifference or antagonism by veterinary staff. Frustrated by the lack of professional growth and ability to actualize modern zookeeper practices, Topaz' entire cohort of keepers left LWE by 2014 and new handlers were recruited to resume training with her. While housed indoors, Topaz's bumblefoot worsened, with indeterminate etiology; consequently, Topaz was returned to her outdoor aviary. Today, Topaz lives free-lofted in a 12'x 10'x 8' aviary away from public view and participates in programming three days per week. During each session, she is prompted to signal her intenetion to participate in programming by willingly stepping up to a home-base perch. Once on home-base, she is prompted to step onto the glove, and hold for jesses, swivel, and lead placement. Once equipment is secured, she is transported on-glove from her aviary to the exhibit hall, where she is perched and tethered in a spacious, enclosed public display arena until the exhibit hall closes at 5:00 PM. With the exception of breeding season (March), when she lays an average of three unfertilized eggs, Topaz willingly participates in glove training and programming. Throughout the breeding season, her diet is augmented to accommodate seasonal weight gain and

associated nutritional needs, and allowed prolonged periods of rest and enrichment following egg-laying.

Training Topaz for Outreach

In late 2016, organizational leadership (executive director and board of directors) requested that Topaz make her debut outside of the facility during LWE's largest annual fundraiser, scheduled in late April. Despite having several months to achieve this relatively simple training goal, veterinary leadership actively resisted keepers' plans for expanding the breadth and depth of Topaz's training, deepening an already-widening inter-department philosophical and professionally hierarchical schism, and confounded by frequent interpersonal conflict among department leadership. As a result, keepers missed their April target, leaving executive and board leadership to question the professional acumen of keepers and their personal commitment to LWE's mission. The degree to which LWE departments were siloed and obstructing each another's goals had become clear by this time to a relatively new executive director. As a result, comprehensive restructuring of department positions and staffing models were initiated for AE, Education, and Hospital (veterinary staff). With new leadership recruited to actualize a highly-collaborative, inclusive, and respectful culture, the goal of debuting Topaz during a September fundraiser was established. Each of LWE's eight departments – from Administration to Operations – was invested in achieving the goal and supporting keepers. LWE's Board of Directors was also engaged to buoy keeper support for this and other AE initiatives that improved wildlife ambassador welfare *and* enriched guest experiences.

Training Techniques and Goal Setting Strategies

To achieve the goal of integrating off-site public appearances in Topaz's training repertoire, two objectives had to be realized: 1) acclimating Topaz to short-duration transportation experiences, and; 2) hood training. Based on protocols developed for smaller raptors, a large (2'x4'), three-sided enclosed kennel was purchased. Additionally, Topaz was desensitized through positive associative training to accept a Dutch-style eagle hood during short (0.5-5 minute) training intervals concurrent with feeding sessions. Training would begin following Topaz's egg-lying season ended in March, allowing for approximately five months of training.

Challenges

Topaz laid her last egg of the 2017 season on March 3rd. Hood desensitization and training commenced on March 9th and proceeded swiftly. Within twelve weeks, Topaz accepted the hood, was removed from a perch on glove, and escorted from her aviary to the transport kennel. During each training session, the hood was left on for increasingly longer periods of time to expedite the desensitization process. During the twelve weeks of hood training, Topaz exhibited a novel behavior once the hood was removed - she repeatedly opened and closed her mouth and extended her neck, as if to indicate the chinstrap was uncomfortable. In response, keepers modified the size of the hood, but the new behavior persisted. To prevent losing strides gained during accelerated training sessions, keepers switched to using Topaz's familiar hood used during medical exams, which features two adjustable straps to increase flexibility and controlled fit around the chin area. This hood was not initially considered for public outreach training because it requires more handler maneuvering and can be difficult to place on the bird while on glove. Although Topaz has donned this hood for over a decade, she nevertheless exhibited the novel behaviors indicating discomfort, as with the Dutch hood. While these behaviors may be solely associative and

unrelated to any actual physical discomfort, keeper staff opted to discontinue hood training altogether and proceeded with kennel training without hooding.

With only six weeks left before her public debut, Topaz's hood training setback imposed a significant challenge. Since she had invariably been hooded in previous training sessions, Topaz had never actually seen her transport kennel. To quickly desensitize her to the kennel, the unit was placed immediately adjacent to her aviary, while short-duration approaches were made on glove with the kennel entrance fully ajar. Within a relatively short/period of time, Topaz willingly entered the kennel, stepped off the glove, and remained in the kennel for extended periods of time. The kennel was then transported around LWE's grounds and Topaz was removed from the kennel in various locations. Having overcome short-duration, on-site kennel transport, the final steps in her outreach training included transporting Topaz in a van and acclimating her to the venue and its in-situ conditions.

Outcomes

On September 17, 2017, Topaz was prepared for her debut outreach since arriving at LWE in 2005. During the event, Topaz calmly remained on glove with her handler for a full hour, delighting guests. She has since participated in three well-publicized outreaches, and continues to participate in public program on LWE's grounds three or more times per week.

Future Plans

As LWE underscores all areas of programming and interpretation with environmentally poignant messages, keepers and education staff have opportunities to showcase wildlife ambassadors as successful case studies in population recovery efforts and as focal points for issue-based advocacy and regional conservation challenges. In the case of golden eagles, the highest-known densities of nesting habitats in the world are located in the open grasslands and oak savannahs of eastern Alameda County. Every year, an estimated 75 to 110 golden eagles are killed by the nearly 5,500 wind turbines in the Altamont Pass Wind Resource Area (APWRA) in northeastern Alameda and southeastern Contra Costa counties, within 20 miles of LWE. Topaz serves as a powerful symbol of the complexity of contemporary conservation issues and opportunities for corporations, NGOs and government agencies to work together in service of 'wildlife wins'. Our intention is to integrate Topaz into the entire spectrum of on- and off-site educational programming and community outreach appearances.

**Case Study – Bald Eagle, Atsá**

Background

Atsá is female Bald Eagle (*Haliaeetus leucocephalus*) accessioned into LWE's live collection in December 2016. Hatched in Wisconsin in 2003, a windstorm destroyed her nest, resulting in a fall that irreparably injured her wing and rendered her flightless. Once rescued and determined non-releasable, Atsá was transferred to the World Bird Sanctuary (WBS) in Missouri, where she lived for 13 years prior to being transferred. LWE's previous (male) bald eagle, Sentinel, passed away at the age of 26 in 2014, leaving a

significant programming gap. Atsá's arrival at LWE coincided with rapidly expanding program opportunities focused on conservation-based messaging. The bald eagle's recovery from the brink of extinction and subsequent removal from the federal endangered species list in 2007 was well-aligned with the trajectory of institutional programming.

Training Techniques and Goal-Setting Strategies

While at WBS, Atsá lived in an aviary with a creance and was handled on glove for only short periods of time. At LWE, her goals were two-fold: 1) live in a free-lofted aviary (11'x 9'x 8') while serving as a reliable, manned program raptor, in similar fashion to Topaz's management, and 2) respond affirmatively to weight management. She wore traditional falconry equipment with her anklets and jesses attached at all times to facilitate her adjustment to a novel environment. A team of up to three keepers (but usually two) conducted Atsá's training to ensure consistent handling. Her debut public appearance was scheduled for Earth Day, April 22, 2017.

Challenges

Atsá's first year at LWE was fraught with challenges. Conversations and video footage provided to LWE by WBS prior her transfer suggested that Atsá was manned to the glove. However, a comprehensive assessment of Atsá's experience at WBS remained unclear until well after her arrival at LWE. For example, her overall temperament was consistently highly agitated, willful, and aggressive, even beyond the expected baseline for female conspecifics. Additionally, she was rarely used in programming, and in fact, was one of the last of 16 conspecifics to be used for such purposes, due to her untenable personality. In short, she was not being managed as an individual - that became the mandate for LWE keepers.

Modifying Atsá's behavior for a free-lofted aviary was a significant challenge. Atsá's training plan included weekly weight management targets, with daily diet adjusted accordingly. She was asked to participate in two daily training sessions by moving to a home-base perch and stepping onto the glove, and while she often obliged, she demonstrated resistance by vigorously gripping and biting the glove, as well as making biting overtures towards handlers' faces and hands. Atsá often displayed highly-stimulated behaviors including back feather hackles, raised/fluffed feathers among her body, and aggressive food snatches offered from tweezers during training sessions. Trainers slowly, intentionally, and consistently moved their hands towards her jesses and eventually attached her remaining equipment - the swivel and lead - to the gauntlet. After nine weeks, Atsá was removed from her aviary on glove and walked throughout LWE's facility with increasing distances away from her aviary and eventually to her programming location.

Concurrent with Atsá's training progression, increasing health concerns (poor foot condition and damaged feather molts resulting from permanent wing injury) required her to be caught up for exams seven times prior to her public debut in April. Additionally, she was given daily medications administered in food items, resulting in negative association with one of her main reinforcements – fish.

This was a major setback in Atsá's training plan and ultimately led to fear-based aggression towards trainers. Despite continual challenges, Atsá made her successful public debut on April 22, 2017.

During Atsá's first six months at LWE, keepers were faced with balancing her programming and medical needs while simultaneously build a positive relationship. The "YES" culture that challenged keepers to broaden Topaz's community outreach and programming capacity and allow her to successfully navigate novel behavioral responses seemed to be undermining progress in Atsá's training plan. In May 2017, unanticipated changes in staff resulted in the loss of Atsa's most trusted trainer, and she was scheduled to appear at a highly-publicized event at LWE for her official naming ceremony just four weeks later. Keepers were faced with another challenge - inexperienced bald eagle handlers were now training Atsá while simultaneously learning what the bird needed to be a successful ambassador at LWE. While keepers were able to successfully man her to the glove and participate in programming, she frequently became agitated at various programming locations, often leading to truncated or cancelled programs. Additionally, Atsá's behavior was unpredictable and aggressive, particularly within her aviary, where she frequently charged keepers as they entered. After months of continually modifying her training plan with no significantly positive outcomes, it became clear that a change of strategy was needed.

Outcome

In October 2017, Atsá's aviary was completely remodeled. A small hook was added to the center to safely secure Atsá on a creance, and her perches and platforms were lowered to approximately 1'-2' from the ground. Rather than ask Atsá to move to a home base perch, she preferred to be picked up from her platform. Allowing Atsá freedom to choose her own home base signaled that she had control and agency in the trainer-ambassador relationship. This small choice paved way for increased positive interactions with her keepers. In addition, with her returning to a creance style of management, keepers could safely enter her aviary and pick her up comfortably, resulting in more positive interactions. Her foot condition also improved with the remodeled layout, decreasing the number of times she needed to be caught up for exams. By January 2018, trainers were successfully working with Atsá daily in a positive manner, bringing her in for programming three times per week. On non-programming days, sessions were decreased to once daily.

Atsá's arrival to LWE during a time of significant staff changes challenged keepers in numerous ways. While the opportunity to expand programming with a more conservation-based messaging excited staff, keepers were presented with ambitious deadlines and condensed training timeframes, resulting in frustration by both keeper staff *and* Atsá. Intentional staff replacement at keeper, department and veterinary leadership strata have resulted in unprecedented inclusivity, collaboration, and egalitarian management styles, whereby keepers are empowered to make decisions and voice opinions about conditions that optimize Atsá's experience at LWE. Since Atsá's behavior and trust improved significantly following enclosure remodeling, it was decided that an exhibit visible to the public would not only help in meeting Atsá's programming needs but also in reducing her stress, by limited the distance Atsá would need to travel on glove for her programming. With the sessions reduced to one time a day, the animal keepers saw an increased willingness to participate as well as a decrease in stress behaviors in the presence of animal keepers.

Future Plans

LWE is initiating a capital campaign to construct a unique indoor/outdoor enclosure based on a canyon/meadow wetland habitat, allowing Atsá to be managed in ways in which she feels safe and comfortable. Additionally, the unique naturalistic habitat features of the exhibit – from a wetland where she can hunt fish to snags and branch materials with which she can create a nest – the "eagle eyrie" is an exciting expression of LWE's mission of connecting people with wildlife. Keepers will continue to work with Atsá with the goal of expanding her programming repertoire by participating in community outreach events; her debut outreach is scheduled for September 2018. To ensure a smooth transition during transport, an innovative, custom perching system was designed, built, and installed in a standard 15-passenger van from which the seats are removed.

**Conclusion**

With high staff turnover between 2012 and 2017, Topaz, like many wildlife ambassadors, was perceived as an animal whose training future remained static and minimalist. An intentional institutional culture shift supported and valued keepers as professionals who were not only highly-skilled behavioralists, but also were expected to be partners in the veterinary care and programming trajectories of their ambassador charges. Topaz's willingness to adapt to a dynamic environment, coupled with her calm demeanor, helped her adjust to life in captivity, enabled her keepers to make accelerated strides in enhancing her wellbeing and expanding her programming repertoire and mission impact at LWE. For Atsá, LWE's culture initially undermined her best interests. Ultimately, however, the rapid and significant intentional shift in workplace norms (a "YES" culture) fostered a highly collaborative and respectful environment with keepers and upper management working together to make Atsá to feel safe in her new environment, while also expand unique and exciting programming opportunities for guests. While Topaz and Atsá serve as case studies for the purposes of this presentation, the shift to a workplace culture that values collaboration and input from every individual and organizational stratum ultimately benefits the welfare and holistic needs of all animal ambassadors and wildlife patients under LWE's care.

**Citations**

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# 2018 AAZK National Conference Paper

# Facing the Fire: Safari West's Experience with Disaster

Erika Mittelman & Jennifer Sloat


While disaster is inevitable, we can always prepare for it and most importantly, learn from it. One of the biggest threats we face in California is wildfires. We never imagined that threat would become a reality. California was tragically devastated by wildfires in 2017. Safari West stood in the path of the Tubbs fire and it was a moment that we were unable to entirely prepare for. Our guest protocols were well executed; however, we were not able to fully utilize our animal evacuation protocol. We planned our protocols for a 3-hour evacuation time and ended up having about 20 minutes.

We felt we were well prepared for this type of emergency. We hosted a disaster plan discussion with local facilities. We have annual visits from emergency response teams. We ensure our guest and animal disaster protocols are well-drilled. In addition, back-up systems are in place in case of the loss of phone lines, cell towers and electricity. While we were only able to implement some of our protocols for the start of the emergency, we were well equipped to handle the situation after the fire had passed through. It was the following months that we pulled together as a team, and a community, to make the best of a bad situation and ensure that our animals were well taken care in the aftermath of the fire.

Considering the circumstances, we were very fortunate; this experience taught us a great deal and we hope to share what we learned and collaborate with others to improve protocols for the future.

## Preparation, Planning and Protocols

Safari West created evacuation protocols by monitoring fires over the last several years. We established an incident command center to keep communication logs, check that protocol is being followed and keep track of employee and guest names. We use radios to communicate at our facility and

cell service is very limited. During an emergency, each department a manager will have 2 radios. One radio remains on their department channel and the second will be on our emergency communication channel in order to communicate updates to the command center.

Our first priority is guest safety. Safari West is in a more remote location, outside the reaches of public transportation. Arriving visitors in personal vehicles fill out a registration card when they arrive. This details their vehicle information and name and number of guests in their party. These registration cards are kept together and put in a checklist form in the event of an emergency, making it simple for our office staff to account for all guests during an evacuation. Additionally, we have camera's set up at the exits of our facility which enable us to check vehicle license plate numbers as guests are leaving. Employees are trained to direct guests on the best possible route, with road closures kept in mind. As our guests leave, maps are available to hand out, which is especially useful for guests that are unfamiliar with the area.

In addition to evacuating our current guests, we also have guests on their way to our facility. Since we are reservation only, we do have this information stored electronically allowing us to contact and divert any possible incoming guests. We have our system set up to be accessed by personnel off-site. This allows the on-site personnel to focus on the evacuation, while off-site staff can start our phone tree to staff and incoming guests. To make sure communication can occur and necessary power sources are able to be utilized, we have several back-up systems in place in case of the loss of phone lines, cell towers and electricity.

While much of our staff is working on evacuating our guests, the remaining are focused on animal evacuations. The established order evacuations for our animals centers primarily around location and species. Many of our primates, carnivores and avian species are housed in a manner where the ability to escape if a fire would be near impossible. Due to this factor, we have planned to crate and evacuate these species first. Certain animals are trained to go into crates and trailers, while for others we will need to use chemical and/or physical immobilization to transport them.

Our hoofstock pastures range in size from 2 acres to over 100 acres. The vast majority of these species are unable to be transported in a timely manner. Those that we can move onto a trailer are a priority, however we must keep factors like capture myopathy in mind for many of these animals. We have a protocol to shelter many of these species in place. All of our exhibits are connected by gates and pens. During a natural disaster that does not allow us to transfer these animals, we will open the gates and/or cut certain fencelines to increase the amount of area the animals have access to. Many of these animals have innate and natural instincts that guide them in evading fires. With this protocol, our perimeter fences remain intact to ensure public safety.

In order to keep animal evacuations as smooth as possible, we have designed an organized method that can utilize any Safari West staff members' assistance. We have divided up our staff into 3 essential categories: our capture team, labeling team and phone tree team. Our capture team is responsible for shifting animals into appropriate locations for sedation and evacuation. It is vital for this process to be done calmly as to not further stress those animals and allow it to be executed efficiently. Our labeling team has the duty of labeling crates with care sheets and information on which vehicle they will be loaded on. If able, we plan to send a keeper staff member with each vehicle to their evacuation destination. Our labeling team needs to keep a master record of which animals and staff members are in which vehicle and where its destination is. Lastly, our phone tree team is in charge of overall communication. Our staff on the property will be calling for emergency response. Any staff off-site will be calling for assistance from

others; this includes calling any essential staff that is not currently on site to help with the evacuation, finding extra support from other facilities, and communicating needs such as more trailers and drivers.

We have select staff that is trained to handle and administer certain drugs during evacuations. Our vet office contains a list with the drug name and sedation dosage by species, which is broken down by weight, as prescribed by our veterinarians, for individuals that need to be sedated for evacuation. Other medications are in secure locations that our selected staff can access. It is the responsibility of those staff members to ensure any necessary medications are included in the transport bags for each individual animal.

Just a few months before the Tubbs fire, Safari West hosted a round table discussion with several facilities from around the area (Figure 1). We had a variety of minds, from keepers, registrars and managers to veterinarians and USDA inspectors, all of which shared great information, experiences and innovative ideas to help us all come up with the best plan for each of our facilities. We also discussed how each facility could help one another during an emergency and this ranged from housing animals to providing supplies and personnel to communication and support.


Figure 1

In addition to networking with local facilities, we also make sure to keep close and positive relationships with the community. In Sonoma county, many local property owners have cattle and horses and therefore trailers available and the skills to drive them. Through the relationships we've created we have been able to establish a list of contacts who own and can operate trailers that we can call on in case of an emergency. We also want to make our staff available to assist with certain situations that our community faces if our skills are found to be useful.


Figure 2

We regularly have emergency response teams (Cal Fire, numerous local fire departments, Sonoma County Sheriff, CHP, local police, helicopter, air tanker and fire bomber pilots) visit Safari West so they have an understanding of our property (Figure 2). They will perform guided in-depth walk-throughs of our property. Our local fire departments, police departments and CHP have a detailed map of Safari West input into their CAD systems; this includes animal locations and gate locations. We feel this is important, not only for our animal safety but our guest safety as well.

On top of the preparation mentioned above, we of course use a variety of drills as way of preparing our staff for emergencies. We have drilled animal escapes, natural disasters, active shooters, among several other issues that our facility could face. We have been fortunate to have some of our local officials participate in drills and provide valuable input, so we can constantly improve our protocols and procedures and work cohesively for the safety of our guests, staff and animals.

# 2018 AAZK National Conference Paper

## The Tubbs Fire[1,3]

Figure 3

The Tubbs fire is recorded as the most destructive fire in California history as well as one of the deadliest. It burned through 3 different counties and was 36,807 acres total (Figure 3). 5,636 structures were destroyed, 317 were damaged and there were more than 20 fatalities. Cal fire estimated that there was $1.2 billion in damages. There were several factors that led to this destruction, one of which being the wind gusts of up to 75 mph. This fire burned at a speed of an acre per minute. Because the fire was so overwhelmingly intense, Sonoma County officials decided against sending out emergency alerts due to the possible panic that would ensue, leading to blocked roadways and an increase of possible injuries and deaths. However, Nixle alerts were used after the first night and were vital to alerting people of the quickly spreading evacuations.

## The Night of the Fire

Safari West was lucky to have the little time we did to evacuate. A passerby that was driving away from the start of the fires stopped by Safari West to notify our night ranger. This started our chain of communication. The night ranger contacted our on-site manager who then called our animal collections administrator. Our animal collections administrator called two of our lead keepers, coming from different directions, to help with the evacuations. She also called a manager, who was out of town, to continue the phone tree so she could get to Safari West for evacuations. There were only 3 personnel able to make it up to Safari West before the police blockaded the road.

Our guest protocol was executed very smoothly and calmly. Approximately 90 overnight guests had been evacuated within 30 minutes. Unfortunately, our animal evacuation protocol was not realistically able to be executed due to the short evacuation time. In addition to not having time, there also was not enough staff to safely sedate and transport many of our species. The focused quickly changed from our established protocol to being able to save anything possible. The animals that were evacuated included 9 macaws, 1 cockatoo and 1 sulcata tortoise; these animals were evacuated due to the ability to quickly grab and transport them. At this time, the fire was approaching so quickly, personnel couldn't even access certain parts of the 400-acre facility. Calculated risks and tough decisions had to be made, keeping public safety in mind, while giving our animals the best chance of survival. In order to shelter in place, certain interior gates were opened to increase the amount of space the animals had access to and the giraffe herd was pushed out of their barn into the larger areas. While it was a risk to put animals together that had never co-habitated, we saw no issues for several weeks; it appeared that self-preservation outweighed territorial aggression. Safari West did keep the perimeter fence secured to act as a secondary containment.


Figure 4

Staff was required to leave due to severity of fire, however, our owner, Peter Lang chose to stay on property (Figure 4). Although, we can't advise this as a recommendation to anyone else, due to the severe danger he put himself in, things likely would


Figure 5

have turned out drastically different if he hadn't stayed behind. Peter used garden hoses, shovels and trucks to put out fires, stop progressing fire lines and create fire breaks. At one point, Peter had to maneuver our nyala herd through their burning enclosure to get them to a safer area (Figure 5). Due to his heroic efforts, Peter was awarded the 2018 American Red Cross Animal Rescue Hero Award.[2]

Every single one of our keepers are amazingly dedicated and many attempted to rush towards to fire to help save those animals they have dedicated their lives to. Our staff stepped up to help with evacuated animals from Safari West and of friends and family members. As the severity of the fire was realized, many people needed to account for their own homes and families in immediate danger.

While we were unable to utilize our preparation plans for the start of the emergency, we were well prepared on how to handle the situation after the fire had passed through.

## The Days and Weeks After: First Response and Safety

Not one person believed that Safari West was still standing that night. The next morning 5 staff members were given escorted access to Safari West by 11 am. The roads were all closed and monitored by local officials due to the extremely dangerous conditions. The relationships we had established with these agencies prior to the fire made all the difference that day; there is no way that we would have been able to access Safari West without them. Due to the dangerous conditions and poor air quality, staff was only able to stay for a short period of time. The priority was checking for life. All the animals, as well as Peter, were safe. We also needed to ensure our perimeter fences were secure and worked on putting out any active fires on the property that would be an immediate threat. There was damage to several enclosures, many vehicles and equipment were lost, but all of it was repairable and replaceable.

Communication was difficult due to no power or cell service. One of the staff members that was at Safari West was able to use a radio to communicate the conditions with a person off-site. That person then relayed that information to the rest of our animal staff through text messaging. Staff that were not at Safari West, received confirmation that our facility was still standing, and the animals were safe at 2:40 pm.


Figure 6

Several staff members stayed on property overnight to monitor any fires that may ignite. We realized how valuable our cross-trained staff were. We were fortunate enough to have a keeper that had firefighting experience (Figure 6). He was not only able to monitor and put out fires, but also train others on safe practices. We have two working fire trucks and a water truck on property and have several staff members trained on these vehicles. Having these vehicles to use was extremely advantageous. Another staff member that is particularly valuable is a former emergency room nurse who lives on site at Safari West. She was able to monitor staff for any injuries or possible illnesses.

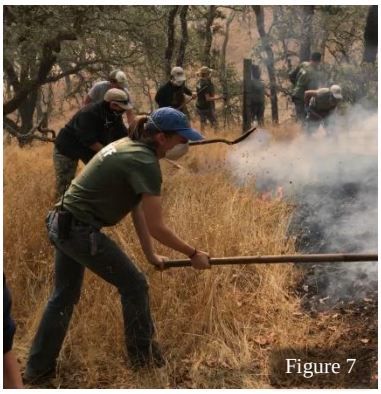
Figure 7

The days and weeks after the fire, we had to make priorities due to a small number of essential staff allowed at the property and limited resources. Our animal staff performed standard health checks, provided fresh diets, replaced water when necessary, and monitored for critical behaviors. Our maintenance team secured fencelines, acquired generators and monitored water use. All staff was responsible for monitoring fires and keeping areas from igniting (Figure 7). The tools that were consistently being used included our fire trucks, tractors, water trucks, shovels, fire extinguishers and many hoses. Water had to be closely rationed until we got enough power to get the pumps for the wells working.


Figure 8

One of the biggest concerns with our essential staff was the possible smoke inhalation, as there was a lot of ash and chemicals in the air. At first many of our staff members were just using shirts, bandanas and dusk masks since that was what was available. We quickly learned which masks were needed for safety: N95 masks (Figure 8).

At this point, Cal Fire had other priorities and were no longer able to be present in the area since the fire was still spreading and the priority for them is to preserve human life and stop the spread. Although, Governor Brown saw Safari West in the media and had a representative from Cal Fire check on us during that first week. Since the fire was still spreading rapidly with little containment, evacuation areas were continually expanding. This happened for about 2 weeks and continually affected the availability of our essential staff.

The offers for help at this time was overwhelming and they came from all over. People were looking for literally any way to contribute. Whether it was their time, their property, to house both animals and displaced staff members, or even supplies, but we needed to keep safety in mind. We could only let essential and well-trained staff assist at Safari West due to road and health restrictions; past and present highly trained keeper and maintenance staff were prioritized.

## Stress & Anxiety


Figure 9

It quickly became apparent that staff was stressed regarding their personal lives and the lives they take care of. Everyone was anxious to try and get as much of the daily routine as possible back to “normal”. When issues arose, we all needed the reminder that everyone is tired and stressed, and that each person handles the stress differently (Figure 9). Understanding was critical at this time as there were countless stressors. Some people were evacuated or weren’t sure if they would be evacuated, there were feelings of helplessness and the travel time to get to and from work increased (for some employees it took triple their normal time due to road closures). Some employees had to leave for personal reasons and we had to lay-off a number of employees much earlier than planned. Some of our staff had friends and family who had lost their homes, and some had lost their homes themselves. We chose to alter our essential staff’s normal working schedule and tried to only have someone work 3 consecutive days and within those days we reduced the amount of time spent at the facility. We had to closely monitor what time we left Safari West as there was a curfew in place set by law enforcement to try and combat looters.

It was incredibly important to try and keep moral up during this time. The keepers emphasized that reinforcement and encouragement from management that this is a marathon not a sprint, helped keep things in perspective.

Our essential staff met at a location about 7 miles away each morning to get our escort up to Safari West. Many staff that were not considered essential staff, and therefore could not go up to Safari West, met there to provide coffee and breakfast and be part of the effort (Figure 10). Each department supervisor would communicate with their team through text messaging. An employee only Facebook page was created allowing for continuous communication among all staff. Our owners ensured that breakfast and lunch were provided to all our staff by our amazing chefs, which allowed for recuperation time and staff bonding. The presence and support of our owners during this time was very powerful and comforting (Figure 11).

Figure 10 & 11

## The Months After: Rebuilding

We had finally reached the point that we could transition from crisis mode to maintenance mode. The roads were still closed, meaning we were still unable to drive up to Safari West without permission. We were able to have more staff join us at Safari West and therefore started creating checklists to ensure all of our employees were accounted for. We did still have a specific time we were required to leave Safari West by, as required by our officials. During this time, the national guard had taken over and were stationed at the bottom of the road, which led to small issues in getting approval to drive up. Our relationships with our local officials again proved to be beneficial for accessing our facility.

Communication with our vendors was needed since their vehicles could not access our facility. They were very flexible, and we were able to arrange to have them meet us in the morning and transfer the items to our work trucks to bring to Safari West. We received a lot of food donations as well. One was from a local grocery store that was also in the evacuated area and consequently they were not able to utilize the food that was in their store.

We started to assess our damage and repair what we could. We had serious smoke damage to many of our buildings including our giftshop, tent cabins and kitchen. We hired a professional smoke damage cleaning team to ensure all areas were taken care of properly.

Figure 12

We made sure all staff on property were well trained to be aware of hot spots and widow makers (Figure 12). We noticed an increase in air traffic. There weren't just emergency responders, but now PG&E as well as numerous media sources flying over our facility, many of which were flying low. This isn't something our animals are acclimated to, so we monitored close for any signs of distress from these changes.

We were finally starting to return to normal. We started shifting animals back to their original enclosures and many of our evacuated animals returned. We, of course, needed to reseed the burn areas to assist in new growth. We were still unable to do full cleaning since we were not able to haul waste off the property quite yet. Due to the low number of staff and no guests present, this allowed time for other

projects to be completed, now that everything had calmed down. For instance, this gave us the opportunity to safely capture and transfer several of our Cape Buffalo.

## Medical Monitoring

Every day after the fire, the keepers have been hypervigilant for any signs of medical issues. They were looking for distress, subtle behavior changes, respiratory symptoms (especially in birds) and signs of a compromised immune system. We wanted to ensure there was no motivation for animals to eat off the ground due to the large amount of ash and burned vegetation.

Our veterinarian was able to use our previous relationship with UC Davis to allow us to become part of a large, long-term study looking at effects of the fire post death. Any animals that have deceased since the fire have had several tissue samples sent to UC Davis for analysis. We had an impala pass from a cause unrelated to the fires and were able to send her to UC Davis for a full necropsy and tissue analysis. They did not find any evidence of chronic smoke inhalation and no apparent airway damage. This was great knowledge to have; it gave us confidence that our animals are even more resilient than we anticipated.

## Public Information & Support

We made the decision to take the media head on. We knew there was no way to stay out of it, so we wanted to embrace and attempt to remain in control of the information being shared. Our media team made sure to give the same message to all outlets to avoid any contradiction. We essentially wanted to be proactive in terms of providing information, rather than answering questions.

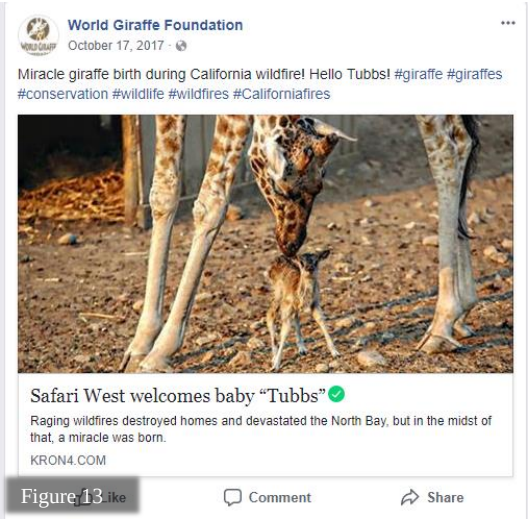

Figure 13

Regardless of our continuous efforts, there were a few incorrect stories that were published. One of these stories was about a baby nile lechwe. The photo and article were correct the first time, but before we knew it, we began seeing articles that claimed "Tubbs" (named after the fire) was a brand-new baby giraffe (Figure 13). Unfortunately, "Tubbs" passed from congenital defects shortly after these stories were published, and even though we publicized this information, we still get people asking about how our baby giraffe born during the fires is doing. There were many other rumors that spread, many of which we have no idea how they started. To assist in avoiding rumors, we have a strict rule that staff should not speak on behalf of Safari West without approval.

We wanted to remain transparent but, as much as possible, also stay positive for both staff and the public, and therefore attempted to promote stories that focused on those positives. The biggest information we tried to circulate was the fact that Safari West survived this tragedy and the heroics of our owner, Peter Lang.

The immeasurable support we had was unbelievably uplifting. Our community, our families, our friends and people we didn't even know were looking for ways to help. We felt it was our responsibility to inform the public of both credible fundraisers, along with the scams. Most of these were promoted using the Safari West Facebook page.

Figure 14

There was a generous GoFundMe account started for Peter and Nancy Lang, but they wanted the funds to go to the staff members who lost their homes. Colors for Conservation created a Safari West design and donated proceeds to that GoFundMe (Figure 14). We had other facilities that reached out to assist with personnel, they sent letters of support, baked goods, gift cards and even enrichment items for our animals.

We wanted to give back to our supportive community. We helped our neighbors get up to see if their houses were still standing, we cared for our neighbors' animals, we assisted in live trapping cats that were displaced from their families by the fire. We try to pay the support forward with any other facilities that have been in a tough situation, whether it be a natural disaster or something else. One of the most rewarding ways we were able to give back was to provide a short moment of refuge for first responders. We offered tours, meals and water and hopefully a moment of relaxation for all of those that are working so hard to save our community (Figure 15).


Figure 15

## Moving Forward & Looking Back

After the experience we had, it was imperative to reflect upon this and figure out what we could have done differently or improved upon. We may have had more of a perspective if we would have lost more or had more time to execute our evacuation protocols. It is hard to say if more people at the facility the night of the fire would have helped or not. With the short evacuation time, we may have been able to get more animals out, but it also would have put more human lives in danger. When reviewing the choices that were made that night, everyone seems in support of those quick decisions. Our staff did their absolute best to keep as many people and animals safe as possible as the fire was approaching.

When we were in our rebuilding phase, we could have organized ourselves better to know what help to ask for. It would have been beneficial to be more direct in what our needs were, so we could better utilize resources from other facilities, like accepting more browse since many of our trees burned. Another matter we could have handled better was the cleaning of our larger exhibits. We were not able to get our waste removed, but there was a neighboring property, owned by Peter and Nancy, where we could have potentially created a compost pile.

We realized that you can never have too many hoses and trimmed grass, even if it is from overgrazing, can be a lifesaver during a wildfire. We are still rebuilding and recovering. We have replaced most of our lost vehicles. We have repaired and been able to improve our exhibit and perimeter fencing. We increased the number of locations that house fire extinguishers, including placing one on every vehicle. Fire alarms have all been replaced and improved: we are now using the nest system which sends phone alerts.

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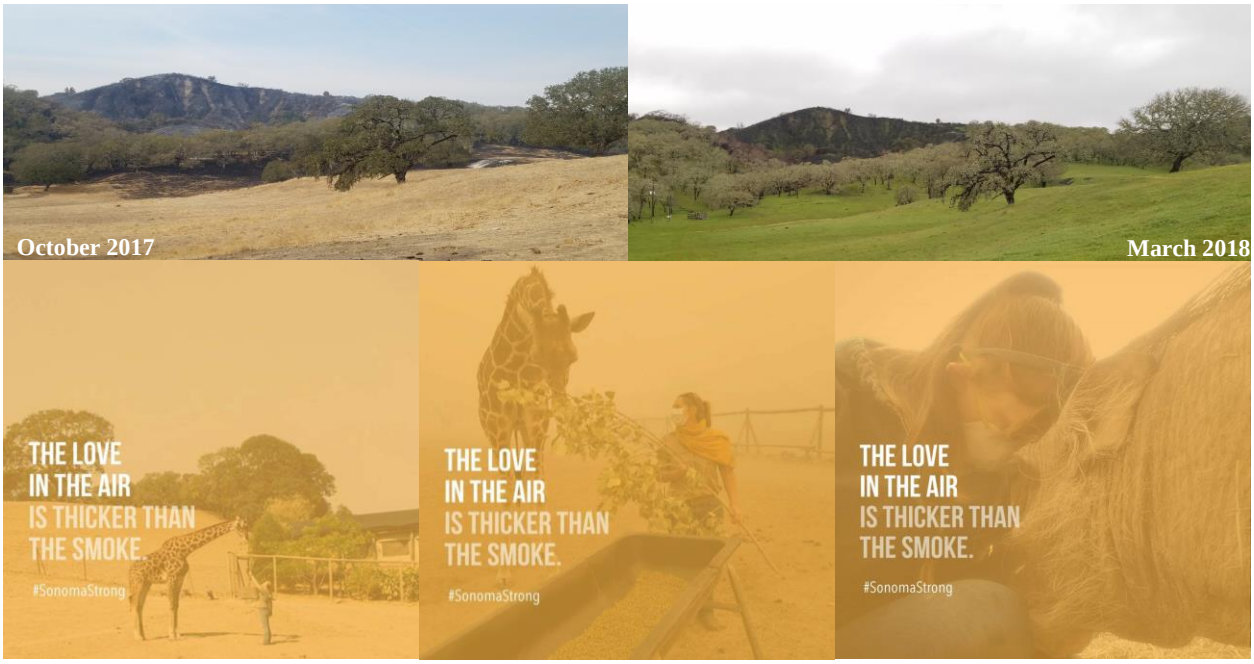
Since the fires, we have been working on expanding the number of people (and variety of departments) trained on a larger variety of vehicles and equipment. We have had local fire departments and Cal Fire show us how to properly utilize our fire trucks.

Safari West reopened our safari tours on November 20th, 2017, which was 43 days after the fire. Our tent cabins remained closed until March 1st, 2018. We continue to learn a great deal from our experience. We have since been able to collaborate with several other facilities to share what we went through and learn from others. We are incredibly fortunate that we remained relatively safe during the wildfire so that we have the ability to share this. We all depend on each other during these difficult moments. All in all, the most significant outcome from our experience was the overwhelming support. It is the support we receive that allows us to stay positive, move forward and continue to improve the lives of those animals under our care.

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# HOPE AND NORA: INTRODUCTION OF TWO JUVENILE FEMALE POLAR BEARS (*URSUS MARITIMUS*)

Joanne Randinitis and Janine Bartling

Utah's Hogle Zoo, Salt Lake City, Utah

**Abstract**

Fall 2017 marked a big change for the Rocky Shores bear team at Utah's Hogle Zoo: the arrival of two young female polar bears. UHZ's older female polar bear died of kidney failure in the Spring and the SSP recommended that Hope and Nora come to our facility, necessitating management plans. Nora was hand raised, house minimally with conspecifics, had an international internet following and was very focused on people. Hope was mother reared, minimally trained and approximately 100 pounds larger. Prior to their move to Utah, Hogle Zoo modified the exhibit to include more den space and shade, better drainage, increased camera coverage, and more landscaping. Ports for head and foot cages were installed in several training spaces, including a public training demonstration space. Staff travelled to each bear's facility and shadowed keepers to learn the bears and how they were managed. Keepers from the transfer facilities came with the bears and stayed to help with the transition. Caring for young bears has tested our organization, planning, and creativity. They have surprised us at every turn and have proved us wrong repeatedly. The have made us laugh and cry--sometimes in the same day.

## Induction

Rocky Shores at Utah's Hogle Zoo is a dynamic exhibit representing a northern pacific cannery that opened in 2012. The exhibit is approximately 8 acres and includes Californian sea lions, harbor seals, north American river otters, American bald eagles, grizzly and polar bears.

In the spring of 2017 Hogle Zoo's only polar bear, Rizzo, passed away due to kidney failure. The loss of this animal impacted the entire zoo community and the Rocky Shores staff. The absence of bears in the rocky coast habitat provided an opportunity to make slight modifications for future bears should they become available. The exhibit was modified with more animal shelters, plants, drainage, and video recording equipment. The Zoo then waited to see if a recommendation would be received to house more bears.

## Research

News quietly spread at the 2017 AZA Bear TAG meeting in Milwaukee. World famous Nora was currently living alone at the Oregon Zoo. Born in November 2015, she was rejected from her mother at a few days old. Keepers at the Columbus Zoo stepped in and hand reared her. She quickly became an internet sensation. As Nora grew it became clear that she had some behavioral and physical limitations. She was moved to the Oregon Zoo in hopes of bonding with their older female bear, Tasul. Sadly, Tasul passed away from cancer before she and Nora were able to fully integrate. Nora's skeletal issues were diagnosed as metabolic bone disease, especially prevalent in her forearms. Her ulnas grew at a different rate than the radius causing a bowing of her front legs and stiff joints. Pain medication was prescribed.

Her behavior issues included a catatonic state when she first encountered Tasul, stereotypic pacing, petulant outbursts, self-directed suckling, and humming like a newborn cub. Anti-anxiety medications were administered as well as an extensive behavioral management plan including enrichment, training, and management practices. She was also involved in a project that included data collection in Oregon Zoo's swim flume, a device which measures metabolic output of polar bears as they swim.

UHZ sent the polar bear Primary Keeper to the Oregon Zoo to study Nora's life there. Every aspect of Nora's life had been documented from the first day of hand rearing, but being with her current keepers was invaluable. A month later her keepers from OZ traveled by truck with Nora to Utah to aid in the transition.

Hope was born in December 2015 at the Toledo Zoo. Her keepers at TZ stated she was a 'typical cub' and her upbringing was unremarkable. The Lead Keeper of Rocky Shores flew to TZ the week before she was set to leave Ohio in order to gain a better understanding of Hope's routine. One week after Nora's arrival, the team from Toledo, along with Hope, arrived in Utah.

As the summer progressed relationships across AZA institutions were sourced for information on introducing bears to each other. Anecdotal stories of previous introductions at other institutions proved invaluable in planning the steps that UHZ would take when the time was right for these young bears to meet. Institutions that shared their experiences included Assiniboine, Toronto, Toledo, Oregon, San Diego, Cochrane. JoAnne Simerson and Else Paulsen also contributed

**Our Plan**

Step 1: Preparation for Introduction (formatting of the following bullets seems weird?)

* Recalls established for all bears

* Allow bears to smell each other while living in the same building

    o Expected Outcome: Both bears will react to each other's smell initially but will become de-sensitized to it over time

* Present items to each bear that the opposite has used

* Monitor reaction of bears

* Continue with this plan until curator and staff are comfortable to move on

* Bears need to have individual access to the exhibit where the introduction will take place

    o Rocky Coast (polar bear exhibit)

    o Bear Meadow (grizzly bear exhibit)

Step 2: Introductions on exhibit

* Bear will be offered their diet first thing until they stop eating, satiate them

* Nora will be medicated and on exhibit first

* When ready, keeper will open green onto exhibit for Hope

* Have all equipment and people in place

    o Hose on roof of demo room

    o Hose at bobcat gate

    o Hose on roof of pinnipeds

    o Noise makers (airhorn and metal dishes)

    o Whole apples/oranges/yams present if needed to distract or redirect bears

* Once the bears have access to each other, staff need to be mindful if they are visible to the bears.

    o Intro can be observed via remote cameras from keeper area or from public side/front of exhibit

* Clearly discuss plan and make sure everyone is clear on what the expectations are for each individual

* Make sure objects that could create tension or an argument are removed from the enclosure

* Enrichment should be provided this will allow displaced behavior of feigning interest in something else while watching each other. (No bones or meat of any kind)

* Monitor behavior of bears

* Separate bears if necessary

* End introductions on a positive note if possible, let bears separate themselves

* Continue this process until Curator and staff are comfortable that behavior of the bears merits allowing bears together for 24 hour periods

* Attempt to provide reasonable solutions to any undesired behavior

    o Toss task oriented, manipulative enrichment devices, ice blocks or whole produce into exhibit

* Remember that any intervention will reinforce the aggressor

    o Unless there is a medical concern, Animal Care staff will not intervene

* If things turn negative start over at the appropriate step

Expectations:

* Both will have a difficult time with the introduction initially

    o Important to let them work it out

* Might react to each other's presence likely with, but not limited to chuffing, huffing, bluff charging, jaw popping, vocalizations, and physical contact

* Stereotypic behaviors present from both in the beginning

    o It is probable that stereotypies will subside throughout the introduction process and the two will eventually begin socializing

Did you discuss wounding and any associated parameters to be tolerated?

**What Actually Happened**

Despite having researched and developed a plan on how to "best" introduce these two young bears, they had their own agenda.

The whole bear building was placed under quarantine, which allowed staff to keep the two polar bears separate. With the holdings and the grizzly bears preparing for winter on exhibit, staff were able to rotate the polar bears between a variety of spaces in holding, including two outdoor yards with pools. This allowed olfactory but not visual access. We also rotated manipulative enrichment devices. Even though the bears became desensitized to the smells of the other bear and we provided as much space, training, and enrichment as the space allowed, each bear grew restless and started to exhibit stereotypic behaviors. Due to these negative behaviors and the complex medical histories, as well as the entire bear facility already being under quarantine, the timeline of introductions was accelerated. Individual bears were allowed onto the exhibit.

Each was allowed to explore without the added stress of the other bear. It was expected that they would also be able to pick up the scent of the previous, geriatric polar bear, as well as the scents from surrounding exhibits. In addition, there would be guests at the windows, eager to catch a glimpse of one of the new bears. By accelerating the plan, the bears had not yet been trained for recall. They were not proficient at responding to their names; trainers had only been working with them for a few weeks and hadn't yet established strong relationships. Staff needed the bear on

exhibit to shift back into holdings so that the other bear could go outside on exhibit for the day. They surprised us and shifted well.

Each bear had already shown preferences for certain areas of the exhibit when they were on their own. Staff were hopeful that by having their own comfort zones, they would feel free to retreat to those spaces. It was decided to have both bears on exhibit at the same time and separate them at night. This allowed staff to be present in the event of conflict between the bears.

On the first day both bears were shifted together on exhibit Nora charged at Hope. Hope defended herself and bit Nora on the Nose. They then ignored each other. According to the plan, multiple enrichment devices with low value food like chow were scattered around the exhibit. Large amounts of enrichment around the exhibit to diffuse any issues or for the bears to feign interest. At the end of the day, one bear was shifted in and separated for the night. This continued for a few weeks but the bears were observed getting closer and closer to one another.

As the distance started to shrink, staff expected that Hope would make the next move. Nora was nervous. She would look at Hope but seemed unsure of what to do. She would move to Hope and then run away, often exhibiting contradictory body language. She simply did not "speak bear". Hope was very patient through all of this. She would bring Nora toys and Nora would look confused. Hope would just walk away, only to repeat the behavior later that day or play posture or pounce on the devices while Nora was watching. She was persistent and wanted Nora to respond.

Throughout this process they always had access to the holdings within the building. The exhibit was arranged to eliminate the chance of a bear feeling cornered by the other bear. Despite them not physically interacting, the bears seemed to tolerate sharing space with one another. After a few weeks night separation was discontinued.

By December, after three months, Hope's perseverance paid off. Nora figured out what Hope was saying and she started playing back! Nora watched Hope pick up an enrichment device and pounce, she then mimicked what she saw. Hope noticed this and would bring devices closer to Nora. Soon they were sharing the same objects.

On what seemed like a typical, uneventful day as the keepers were packing up and heading to their cars, a quick check on the bears revealed they were both in the back-holding yard together, which was slightly unusual. After a few minutes of observation, it became clear they were not just in the same area, but actually choosing to be close to each other and PLAYING together. Hope took on a submissive stance and rolled on her back. Nora climbed on top of her and they gently bite each other in the face. It was over as quickly as it started--approximately five minutes. The fire was lit for each of them to seek out more interactions. The next day, the bears were on exhibit when keepers saw them wrestling, which continued throughout the day. By the end of the week they were playing in the exhibit pool together for the world to see.

From that big step, keepers have noticed some changes in both bears. It seems that there is a constant study of each other with each picking up mostly good and some bad behaviors from the other. Hope has always been very agile and quick to destroy enrichment and items in the exhibit, and Nora has learned these behaviors. They will often mimic each other when it comes to pouncing on barrels to digging up trees. Hope has learned to trust her keepers more, which was less of a challenge for Nora, who learned early to rely on people for everything in life. There has been an increase in the level of trust that Hope has for her keepers. Nora still vocalizes like a young cub and Hope has picked up this behavior. Other behaviors leave us optimistic for the future of each bear. Hope will act submissive and maternal towards Nora and exhibit tremendous patience for Nora's learning process. One day she could be an excellent mother bear. Nora pushes herself physically to engage with her surrounding and keep up with the bigger bear. Her physical limitations have rarely kept her back in her drive to engage with Hope. Overall, we have seen Nora become a more confident bear because of Hope. Most importantly, Hope taught Nora how to "bear".

**Conclusion**

Even though Animal Care staff worked on creating a management plan for the bears prior to their arrival, it was ultimately the bears themselves who dictated how their introduction would proceed. Keepers gathered as much information as possible to allow them to succeed; Hope and Nora worked the hardest when it came to the introductions. It was important to give them as much time as they needed and provide them a reason to get close to each other that did not involve keepers. By making sure that the bears had a variety of enrichment, they could interact with objects that brought them closer.

Removing the keepers from equation was challenging. As their caretakers, keepers want to help but at the same time it was very necessary that staff were not associated with any of the interactions between the animals. This was more important because Nora was hand raised and very dependent and imprinted on people. The goal was for her to be independent and confident in making her own decisions; keepers are there as trainers but not there for her to rely on as human parents. These are hard life lessons, but in the end, she learned how to be more independent and how to communicate more with Hope.

Nora's bones and her growth will continue to be monitored. She spends a lot of time in the pool and has grown, all of which seems to have had effects on her legs. Keepers work closely with our veterinary team to evaluate her medications based on her condition and growth.

Going forward, trainers will be working on cooperative feeding. The bears are working more closely with trainers. For public demonstration a training presentation room is utilized daily to share information about the bears with the public. Recently both bears voluntarily trained together in this small space. Each bear made the choice to be with their trainer and not leave the session. Training with the head cage and blood sleeve has also started with both bears.

Work with these young polar bears is constantly evolving. Even though keepers gathered the research and information thought needed to make the decisions for their welfare, they continue to surprise everyone daily with what they think is best. They can be silly, loud, demanding, and adorable, but they are also amazing ambassadors for their species and the Arctic. She may be Hope for Nora, but they are ultimately hope for us all.

# HOW TO TRAIN YOUR DRAGON…I MEAN PYGMY HIPPO

**ALEXIS DUFILHO WILLIAMSON – KEEPER II**

The Louisville Zoo has been participating in the pygmy hippopotamus SSP since the opening of Hippo Falls in 2002. It is part of the Zoo's Gorilla Forest area. Hippo Falls is an outdoor exhibit that provides a dry upland area and a stream with a series of waterfalls ending in a large pool approximately 5 feet deep. There are two exhibit viewing windows available for Zoo guests. One is located at an upper viewing area, which is accessible by taking the Gorilla Forest Discovery Trail, and the other is located at a lower viewing shelter offering underwater views into the pool.

The pygmy hippopotamus is a primarily nocturnal creature that has only been in a managed population since the early 20th century. Pygmy hippos have long been considered potentially dangerous animals. While caution should be taken when working with any animal, a training program can be built to better the bond between the animal and the keeper, allowing better husbandry and overall welfare to be achieved. The Louisville Zoo has such a program and is playing a part in the behavior and welfare of the next generation of pygmy hippos.

According to section 3.3.2 of the Husbandry Guidelines for the Pygmy Hippopotamus, very little training other than normal management such as shifting is done with pygmy hippos. Many zoos do not allow physical contact with pygmy hippos and consider them to be aggressive animals, so interactions with keepers are generally limited to cleaning and feeding. Over time, as animals have transferred from one facility to another, information has been shared verbally about the aggressive nature of pygmy hippos. More is known today about the behavior of these animals and how to safely work around a potentially dangerous animal. Gone is the day when keepers are expected to enter enclosures with only tools to protect them in order to hurriedly clean and feed these animals. Every animal is an individual and should be treated as such when designing a training program. Safety of the animal and any people involved is the most important thing to keep in mind.

The Zoo is currently home to 1.1 pygmy hippos, cared for in a protected contact scenario. Our program strives to continually push forward the care and welfare of the collection. Staff has taken part in many research projects to better the knowledge of the species. Fecal collection is an easy, non-invasive way to participate in such studies. The operant conditioning and positive reinforcement training program aides in overall health of the collection, and enhances the husbandry and enrichment aspects of the pygmy hippos in our care. Some of the behaviors currently used in the program are mouth presentation, targeting, back up, lie down, come here, and tactile behaviors that allow topical medications to be administered, hand injection, ultrasound and scale stationing. Mouth presentation allows for regular tusk checks. Veterinary staff is able to obtain photographs to monitor tusk growth. Hand injection makes giving vaccines possible, and allows participation in a larger range of studies, such as testing for cortisol levels using ACTH for a baseline. Hand injection also is a precursor to aide in blood collection. Come here, back up, and target all assist in basic shifting, but can also be built upon for more

complex behaviors. Scale stationing is necessary to keep accurate weight records. The program is expanding to include blood collection and ultrasound. The training program leads to hippos that are easier to work around, allowing for hand feeding and physical manipulation such as touching certain body parts.

The Zoo's daily husbandry routine includes several keeper-hippo interactions. Cleaning of the exhibit and holding areas is done in the morning. There is a morning feeding where each hippo receives half of their daily diet. This is usually given during shifting, and may be all at once or broken into several smaller feedings. When hippos are on exhibit, there is a noon day training session and keeper talk for the public. The training session allows Zoo guests to see a hippo out of the water and up close. After the training session has ended the keeper steps out and speaks with the guests about why we train our animals, as well as sharing information about pygmy hippos and conservation efforts. In the afternoon, just before keeper staff leaves for the day, the hippos receive the second half of their daily diet. On any given day, staff may include additional interactions to facilitate training new behaviors. Depending on the behavior being trained, one or more staff members may be present.

Occasionally behind the scenes tours are brought to the pygmy hippo exhibit. These tours give keeper staff a more one on one opportunity to share their passion for these animals. Guests are able to ask questions and get an up close and personal view of the hippos. With staff guidance, the guests can even toss peanuts into a hippos open mouth, from a safe distance of course. Louisville Zoo's mission is to better the bond between the people and our planet, and these personal experiences are just one way to help guests connect with the amazing world around them.

The Zoo's behavior management plan for the hippos was taken to a new level in August of 2014 A male calf was born and due to the relationship staff had with the mother, the calf was easily separated for its neonatal exam. Mom and calf could see each other the entire time and neither became anxious during the procedure. After seeing how well this worked we decided to continue to separate them daily for short periods of time. During separations, they were always able to see each other, and if at any time they began to become anxious, such as vocalizing towards each other, they would be reunited. Early in these sessions, keepers would enter the stall with the calf and began to desensitize him to being touched. He could then be placed on a scale for weight monitoring and eventually he was trained to step onto the scale on his own.

As his tusks began to grow, veterinary staff was able to routinely photograph the tusks and then monitor their development. By the time he was a year old, I was able to hand vaccinate him. When he was 9 months old, staff no longer entered in with him, but continued to train in a protected contact setup.

When he left Louisville at 22 months of age, he was able to come when called, open mouth on cue, and was injection, scale, and crate trained. When staff from the receiving zoo arrived to transport him, they were amazed that he, as well as both of his parents, were so easily touched and hand fed. With no previous history with pygmy hippos, all they knew was what they had read in the husbandry manual and what they had heard from other professionals about how aggressive pygmy hippos could be.

When staff arrived from the receiving zoo to transport him, the crate did not fit into the adjacent stall like we had trained him. The crate was set up in the service area, attached to a transfer chute. He began to enter the crate, but became nervous in this new location and backed out. With some enticement, he finally shifted into the crate and was loaded onto the transport truck. I followed the transport truck to the new facility, and upon stopping for refueling, was able to offer him some favored treats. Transportation went smoothly, and he readily exited the crate into a quarantine area. He immediately began to explore this new space, and was eating by the end of the day. I returned the next day to check on him and share behavioral information with the staff. They were delighted that he was so easy going and they could hand feed him with no problems. He quickly became a star amongst the staff, and visitors enjoy seeing him on exhibit. Staff has reported that he continues to shift well, and trains readily. On his third birthday, after not seeing him for a year, I made a visit to his new home. He has settled in well and the staff loves him. He came over to me in holding and allowed me to give him chin scratches, one of his favorite enrichments, and hand him some treat items. He easily shifted out on exhibit when told.

The Gorilla Forest keepers do daily keeper talks with the public to share information about pygmy hippos in general, as well as conservation efforts. Some items commonly discussed are habitat loss due to palm oil and human encroachment, the bushmeat trade, and population loss due to war and disease. We are proud of our training and husbandry program and are continually looking for ways to take it to the next level. Should another calf be born, a similar program will be implemented to familiarize it with training early. The adults consistently move forward with training goals, and staff is always looking ahead to the next project. One of the future goals will be expanding the training and interpretation while on exhibit. The ability to demonstrate these behaviors to our guests in a controlled setting and interpret how they aide in better husbandry and welfare for the pygmy hippos will allow staff to increase the awareness of these ambassadors for their diminishing wild counterparts.

# Voluntary injection and blood draw training in 0.2 Cheetah (*Acinonyx jubatus*) at the Philadelphia Zoo

Christina Pavia, Open Relief Keeper

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**Abstract**

In October 2016, 0.2 cheetahs (*Acinonyx jubatus*) arrived at the Philadelphia Zoo to live together in the Cheetah Run exhibit. Keepers were excited to work with younger females and started training. The initial goal was to be able to keep them calm while keepers were in the back area as these girls lunged and spit when keepers walked by. The next goal was teaching the cheetahs to step on a scale for monthly weights. After these were accomplished, voluntary injection and blood draws using behavioral restraint were the next goals. The set up at the Philadelphia Zoo is a squeeze-like system at one end of the tunnel that connects the exhibit to holding. A team of four keepers were able to successfully train the cheetahs for voluntary injections and then subsequently, voluntary blood draws. Training these behaviors allows keepers to prevent yearly immobilizations solely to administer vaccines and draw blood. The ability to draw blood voluntarily on these animals when needed allows us to monitor the animals for routine health issues including SSP-desired monitoring for liver disease indicators as well as kidney disease. Additionally, we are able to include our cheetahs in the Barcode of Wildlife project to help combat against wildlife trafficking.

**Introduction/Background**

Over the years, the Philadelphia Zoo has housed many different cheetahs in the Cheetah Run exhibit at the south end of the zoo. In October of 2016, Amani and Kalima came to Philadelphia from the San Diego Zoo and Safari Park. They are full sisters and were around 1.5 years old when they arrived. They would hiss and swat the mesh at keepers, Kalima especially. They were separated into different runs for their diet in the morning. When given bones, the girls did separate themselves in the yard. In October of 2017, a team of four keepers began working with the girls (area lead keeper Ken Pelletier and relief keepers Tanya Pham, Christina Pavia, and Amanda Schmidt).

**The Set-Up**

The Cheetah Run exhibit at the Philadelphia Zoo has a large outdoor, on-exhibit, enclosure along with four inside dens and runs connected by a tunnel system. The runs and dens are able to be separated individually or able to be all accessible. The tunnel system is mesh fencing on both sides and the top while the bottom is a concrete pad. At one end of the tunnel system, keepers set up what is referred to as a squeeze. The squeeze is one section at the very far end of the tunnel system with a piece of plexi in the middle. The plexi leaves an opening on either side of the squeeze for the cheetah to

enter and exit. The cheetah would enter and walk around the plexi pane, positioning themselves in front of the mesh closest to the keeper. The squeeze can be closed off from the rest of the tunnel by a door. The section of tunnel that houses the squeeze also allows for connection to the runs and dens via a door in the back. The squeeze does not allow for keepers to physically squeeze the cheetahs; as the piece of plexi in the middle does not move. Keepers cut out small sections of the mesh to allow for a tail to be pulled through. Lastly, there is a section of the tunnel that lifts up allowing us to place the scale in. This section is adjacent to the squeeze section.

Panorama of the cheetah exhibit. Entry to the tunnel is on the left side of the exhibit.

Tunnel system

Scale area of the tunnel. The front portion of mesh lifts up so the scale can be put in.

Squeeze portion of the tunnel with the plexi in the middle.

**Training**

Keepers started simple with desensitization as the first step. It was reported that the girls did spit and hiss at keepers at their previous institution. They did the same behaviors with us. Desensitization was accomplished by switching up which runs/dens the girls had access to as well as keepers simply sitting with the girls while they were inside in the morning. Once these negative behaviors improved, the keepers introduced tong feeding through the mesh in the tunnel system. It was decided to have two keepers, with each tong feeding one cheetah at a time. Kalima did better if Amani was with or near her, so to start, we did not separate them.

Next, we introduced the scale to the girls. They were let into the scale area one by one to get weights. They were not very affected by the presence of the scale. They were tong fed while standing on the scale as reinforcement.

Following that, the girls were introduced to the squeeze portion of the tunnel. They had to learn that there was a correct way to enter the squeeze to walk around and lay down in the correct position. The cheetah would enter the squeeze and walk behind the plexi looping around it to lay down with their hind end facing the mesh and their head facing the door to the squeeze. This final position was achieved by moving the girls' small increments each day. Amani was the braver of the two cheetahs so she normally participated first. When she was done, we would send her out the door in the back of the squeeze into the first run. Then we would open the door leading into the squeeze and Kalima would enter.

After the correct position was achieved, we added in behaviors Down, Scooch, Touch, and Poke. The cheetahs were being tong fed throughout the entire process with these behaviors. When we would say Down, the cheetah would lay down in the correct location. This was necessary to eventually do injections and blood draws.

We then started with the Touch behavior. We started by just touching with our fingers at the hip area and eventually added pressure.

Once we introduced a blunt needle, we introduced the Poke behavior. Poke is solely for needles. Once the cheetahs seemed to tolerate the blunt needle with pressure, vet techs came down to do injections. The cheetahs had the option to leave the correct squeeze position at any time to get away from the training if they chose to. Both cheetahs normally participated the entire time. The only options ZIMS defines for restraint for sample collection are chemical, physical, or behavioral. Since we did not use physical or chemical restraint, we categorize our training as using behavioral restraint. In December of 2017, both cheetahs received their three vaccines voluntarily through behavioral restraint.

The Scooch behavior was added in next. The position that we deemed correct for the injection training had the cheetah's hind end farther away from the mesh than what is conducive to blood draw training. Once we succeeded in vaccinating, we were able to start touching the cheetah's tails and pulling it through the mesh. Once we pulled the tail through, we taught Scooch, which was the behavior of the cheetah backing up while still laying down, allowing the entire tail to be outside of the mesh when the cheetah reached the correct location. The Scooch behavior was the most difficult behavior to teach. Kalima started by "scooching" on an angle which did not allow the tail to come through the section of mesh that was cut out. We had to work with her on backing straight up instead of to the side.

Once in the correct position, we introduced the clippers to shave a portion of the base of the tail. The clippers did not affect either cheetah. We then brought back in the Touch and Poke behaviors. We started by touching the base of the tail on the shaved spot and then started applying pressure. We then brought in the blunt needle to poke, and also added in pressure. Again, the cheetahs had the choice to get up and move away from participating in the training. Very few times did the girls choose not to participate. When we decided we were ready, the vet techs and vet came down to do a voluntary blood draw. In February of 2018, we successfully drew blood from both cheetahs through behavioral restraint.

**Results and Benefits**

In total, we have successfully drawn blood from Amani and Kalima three times each. We have kept up on the behaviors and plan to incorporate new ones as well. Being able to voluntarily draw blood when needed allows us to monitor certain health issues that cheetahs are prone to including the SSP- desired monitoring for liver disease indicators as well as kidney disease. We do not need to complete yearly immobilizations solely for the purpose of vaccines. This was a driving force to the keepers in implementing this training. In addition to this, we are able to include Amani and Kalima in the Barcode of Wildlife project that helps combat against wildlife trafficking.

**Acknowledgements**

I would like to thank my fellow keepers: Ken, Tanya, and Amanda, for successfully implementing this training with me. We achieved something great and I am honored to have worked with you all. I would like to thank the vet techs, Jenna Heinze and Tracy Cramer, as well as vet, Donna Ialeggio , for your assistance and excitement in this training. I would also like to thank the Philadelphia Zoo for their support of our training as well as their support of my presentation.

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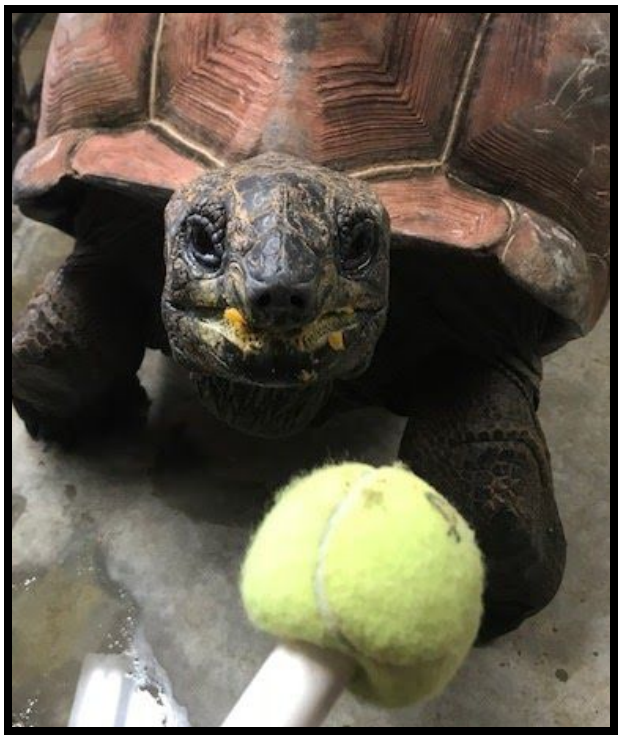
# Target training 1.0 Aldabra Tortoise on an accelerated time frame.



Tiffany A. DeMell
Little Rock Zoo
April 2018

## Abstract

In early March 2018, the Little Rock Zoo announced that we would be hosting a “Spring into Fun” week-long Spring Break celebration with different animal themes for each day of the week. The day highlighting Reptiles and Amphibians featured a Facebook Live weigh-in for the largest tortoise at our zoo. This paper reviews how 1.0 Aldabra Tortoise (*Geochelone gigantea*) with no history of training or recorded weights was scale trained in a three-week time period at the Little Rock Zoo by discussing the methodology, challenges, and outcomes of this training. By adjusting the way we think of reptiles, we pushed past the misconception that reptiles are difficult or impractical to train as well as the idea that training animals a brand new behavior in an extremely short period of time is impossible. Using positive reinforcement with high-value rewards and daily training, Keepers were able to target train this tortoise, use this training to shift animals, and to enhance guest experiences while visiting our zoo and from our social media platforms. Additionally, this paper discusses the implications of this training process on building connections and on engaging staff from different departments at the Little Rock Zoo.

## Introduction

This spring, the Little Rock Zoo featured a “Spring into Fun” week-long Spring Break celebration with different animal themes for each day of the week.[2] The final Saturday of this event highlighted Reptiles and Amphibians, building up to the main event: a Facebook Live weigh-in for the largest tortoise at our Zoo. My goal was to train 1.0 Aldabra Tortoise (*Geochelone gigantea*) to touch a target pole when asked and to walk onto a platform scale to be weighed. Aldabra Tortoises are native to the Aldabra Atoll, part of Seychelles Islands off east coast of Africa north of Madagascar. Males of this chelonian species typically weigh over 500 pounds and have a lifespan of over 100 years.[1] The individual focused on in this paper is full grown, is believed to be approximately 50 years in age, and has lived at the Little Rock Zoo for about 28 years. He had no prior history of training, and historically had not been reliably motivated to move for food. The purpose of this training was to display his weight during a Little Rock Zoo Facebook Live event, less than three weeks away.

Though our tortoises are not in my area, I expressed interest and have been able to assist with their care and to help implement an enrichment program. When this Facebook Live weigh-in was discussed, my Senior Keeper, one of our Reptile Keepers, asked me if I was interested in taking on this challenge and training our tortoise for this event. These sessions needed to occur on a daily basis when possible, so my

co-worker, training as a Relief Keeper for the Reptile Department, acted as my Secondary Trainer during my days off. In the past, negative reinforcement such as gently pinching or tapping his back legs has been used to encourage our male tortoise to stand up and walk toward food offered to lure him inside. One of my primary goals was to complete this training by using only positive reinforcement.

## Challenges and Methods

The Little Rock Zoo has an in-depth training program that all keepers must complete before training any behaviors, as well as an approval process for all new behaviors that goes through supervisors, Vet Staff, and our Training Committee. After submitting an approval sheet with my intended approximations, goals, and reinforcers (see Image 1a and 1b), I was able to begin the training process. From previous enrichment, I knew that a favorite food reinforcer for this individual was melon and juicy fruits, which can only be given in small quantities. After discussing options with the Little Rock Zoo Vet Staff and Reptile Keepers, I reached out to keepers across the globe on Facebook and to a colleague from a previous zoo that I know to be an excellent reptile trainer and keeper. From this collaboration, I found a variety of food reinforcers that could be used on a daily basis; I used a mixture of watermelon, cantaloupe, grapes, tomatoes, apples, and sweet potatoes to begin with and used the higher-value (and higher sugar) items as jackpot rewards.

Once the required approval was obtained, I began training by lightly touching the tennis ball on my target pole to his nose and immediately clicking to bridge[3] the behavior and then offering a food reward on the end of a skewer. He quickly picked up on the notion that the tennis ball meant food for him and would move his head to touch (and sometimes try to eat) the end of the target pole. While I initially intended to shape the behavior to have him actually touch tennis ball, I soon realized that tortoises do not have the best depth perception and loosened my criteria to looking at and being within a couple of inches of the target pole. Once he was reliably targeting, I began to present the cue at a distance that would require him to take a step. After a while, I increased my approximations and eventually began to ask him to walk across the room to touch the target and receive his reward.

One of the most difficult parts of this training was to get his attention at the beginning of the session. Because temperatures were barely above freezing, all sessions needed to be done inside with three other tortoises in the relatively small room, which could make training difficult. I found that using a higher value reward such as melon or cooked

sweet potato would gain his interest faster and would typically keep his focus for longer. Another observation was that he picked up on subtle changes such as his trainer wearing different boots or the shift from pants to shorts as the temperature increased. While these distractions made training a little more difficult, learning that he notices these details broadened our perspectives and gave new ideas for future tortoise enrichment.

At this time, we were unsure of what scale we would be using and were not certain of how high he would need to step to get onto the scale, only that he would need to step onto something. After about a week of training and one week before the start of Spring Break, a red plastic pallet (see Image 3) about 8 inches high was added to his training and he was asked to step onto it. While I had expected this to take a relatively long time to desensitize him to, he did not seem fazed and was standing with all four feet on the platform by the end of this session. A few days later, we were able to borrow the moveable scale from our Elephant Department and found a thick piece of plywood to have him target onto. Despite some issues with getting the board to stay balanced, we were able to train him onto the scale to get our first glimpse of his weight (see Image 4). It was very important to us to know the weight ahead of time in case he was not able to get onto the scale during the live weigh-in.

Our weigh-in was the last Saturday of Spring Break; at the beginning of the week we realized that weather would most likely permit us to do the weigh-in outside in the tortoise yard, which would allow a much larger audience to gather. At this point, he had not been outside for several months due to the colder temperatures and had only been able to train inside. This meant that we had to rely on the idea that we had built a high enough trust bank and had a high enough value reward to take his attention away from basking in the sunshine and from eating leaves to participate in a session. At the end of his first day in the yard, he willingly participated in a training session, successfully stepped onto the scale, and followed the target pole into the Tortoise Barn to be secured for the evening.

## **Results and Discussion**

On the day of the Facebook Live weigh-in, we started the session about 10 minutes before we were set to film and were able to easily target onto the scale for his cheering crowd to display a weight of 580 pounds. Despite the cooler temperatures compared to our previous outdoor sessions, he got up and participated in the training session with minimal hesitation. His willingness to train even while being outside was a huge success

for us, and opened up several more possibilities for more than just this Spring Break weigh-in (see Image 4).

Having an accurate weight for all animals under our care is always beneficial, particularly in regard to healthcare. A major benefit of knowing the exact weight allows for our veterinary staff to more accurately determine dosages for medications and provide a higher quality of care. Maintaining monthly records allows us to observe typical fluctuations and alerts us to atypical gains or losses, which are difficult to determine based on visual evaluations alone, particularly in chelonians. Future training could be built from the initial “Target” behavior to include stationing, stretching, and eventually even injection training and voluntary blood draws.[4]

The ability to train animals that can easily shift inside at the end of the day also helps to improve their overall quality of life.[6] Historically, if temperatures dropped below 50 degrees at night, the tortoises had to stay inside all day to ensure their safety in the cold temperatures- even if the weather was in the 70s or 80s during the day. Now we are able to target our in increments to get them to willingly move across their yard and into the building. Not only is going outside more natural and enriching for an animal, but walking around the yard and back inside provides an excellent opportunity for exercise. Additionally, the observation that this tortoise was easily distracted by minor changes in his keeper and surrounding areas opens up new prospects for improving care through enrichment.[5] Our next step with this training process is to get all four of our Aldabra tortoises target trained to get onto a scale and come inside on their own free will, and to eventually have everyone recall trained to come inside when they hear a bell rung.

Not only was training this behavior beneficial for husbandry, it had a major impact on our public engagement. Every session where visitors were present, we were able to talk to them about training and husbandry and to answer questions about this species. In the days preceding the Facebook Live weigh-in, our zoo created a guessing contest on social media, offering the person with the closest guess a free Zoo Membership or week of Zoo Camp. We also created a contest for zoo staff in which the winner would receive a tortoise painting, which resulted in staff from different departments talking to each other about their guesses and asking about our tortoise and the progress of our training. In total, we had over 50 guesses for the staff contest and over 700 comments with guesses and likes on social media from visitors. On the day of the live weigh-in, our Education Department walked around the Zoo talking to visitors about the event and had over 100 people write down their guesses. Over 200 guests and staff gathered around to watch this tortoise get onto the scale and we received over 2,600 views of our Facebook Live weigh-in.[7] For our moderately small zoo, this was a great turn out and,

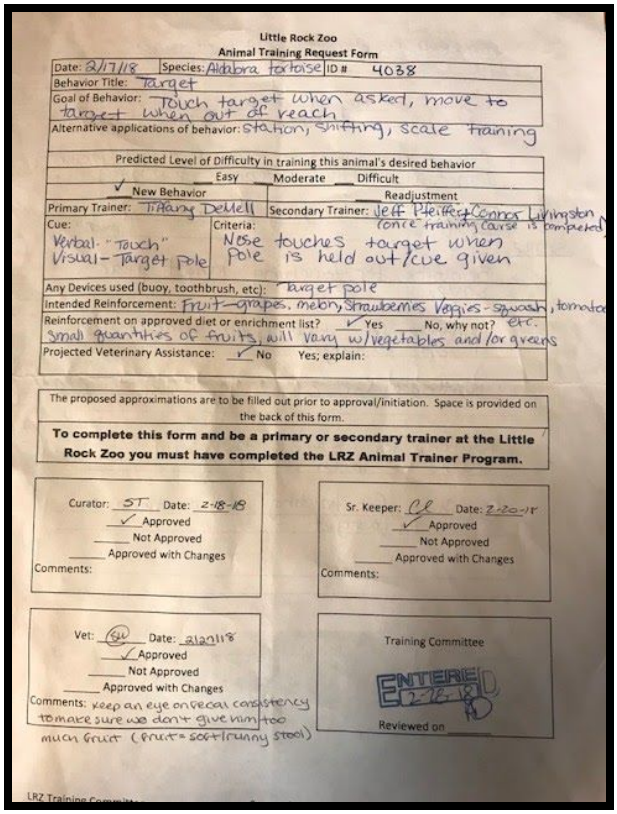
most importantly, everyone seemed to have a lot of fun! In the future, we will definitely be having weigh-ins on different animals and will continue to work with our tortoises.

## Conclusion

We successfully a trained 1.0 Aldabra Tortoise to step onto a scale to be weighed during a live demonstration by using high-value rewards such as melon and cooked sweet potato during daily training sessions. By target training this individual, we are now able to provide a higher quality of animal care by maintaining monthly records and increasing enrichment opportunities. We have even created a new training potential for voluntary healthcare such as recall training, voluntary injections, and blood draws. We are now able to shift this tortoise between his indoor and outdoor exhibit and therefore increase the amount of time he is able to spend outside. From this experience, Keepers have had new opportunities to interact with zoo guests and engage in conversations about tortoise care and conservation. Most importantly, we have been able to adjust our mindsets to see new possibilities for training and enriching reptiles.

## Referenced Images

*Image 1a (below)*



Little Rock Zoo
Animal Training Request Form

Date: 2/17/18 | Species: Aldabra tortoise | ID # 4038
Behavior Title: Target
Goal of Behavior: Touch target when asked, move to target when out of reach
Alternative applications of behavior: station, shifting, scale training

Predicted Level of Difficulty in training this animal's desired behavior
___ Easy ___ Moderate ___ Difficult
✓ New Behavior ___ Readjustment

Primary Trainer: Tiffany DeMell | Secondary Trainer: Jeff Pfeiffer, Connor Livingston (once training course is completed)

Cue: Verbal - "Touch" Visual - Target pole
Criteria: Nose touches target when pole is held out/cue given

Any Devices used (buoy, toothbrush, etc): Target pole
Intended Reinforcement: Fruit - grapes, melon, strawberries Veggies - squash, tomato
Reinforcement on approved diet or enrichment list? ✓ Yes ___ No, why not? etc.
small quantities of fruits, will vary w/vegetables and/or greens
Projected Veterinary Assistance: ✓ No ___ Yes; explain:

The proposed approximations are to be filled out prior to approval/initiation. Space is provided on the back of this form.

**To complete this form and be a primary or secondary trainer at the Little Rock Zoo you must have completed the LRZ Animal Trainer Program.**

Curator: ST Date: 2-18-18
✓ Approved
___ Not Approved
___ Approved with Changes
Comments:

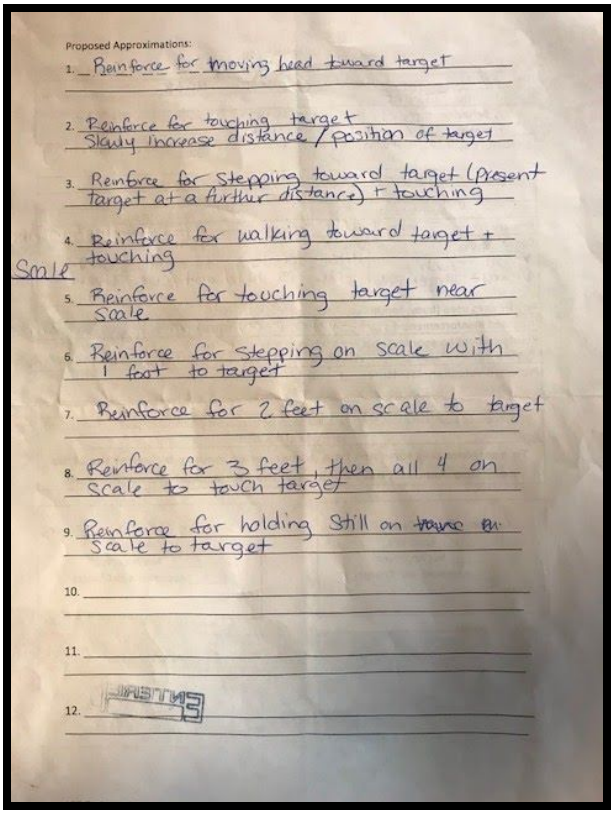
Sr. Keeper: CL Date: 2-20-18
✓ Approved
___ Not Approved
___ Approved with Changes
Comments:

Vet: SW Date: 2/20/18
✓ Approved
___ Not Approved
___ Approved with Changes
Comments: keep an eye on fecal consistency to make sure we don't give him too much fruit (fruit = soft/runny stool)

Training Committee
ENTERED 2-26-18
Reviewed on ___

LRZ Training Committee

*Image 1b (below)*



Proposed Approximations:

1. Reinforce for moving head toward target
2. Reinforce for touching target
   Slowly increase distance / position of target
3. Reinforce for stepping toward target (present target at a further distance) + touching
4. Reinforce for walking toward target + touching
   Smile
5. Reinforce for touching target near scale
6. Reinforce for stepping on scale with 1 foot to target
7. Reinforce for 2 feet on scale to target
8. Reinforce for 3 feet, then all 4 on scale to touch target
9. Reinforce for holding still on ~~target~~ scale to target
10. ___
11. ___
12. ___

*Image 2 (below)*

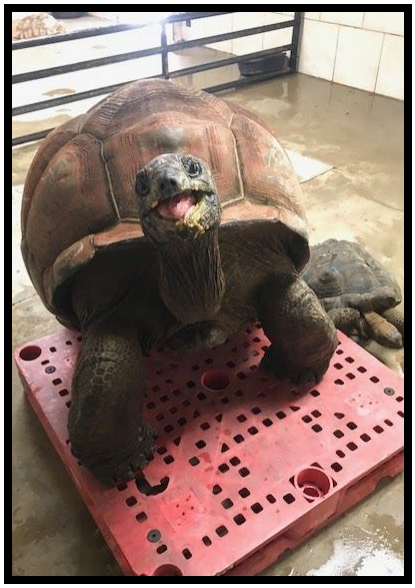
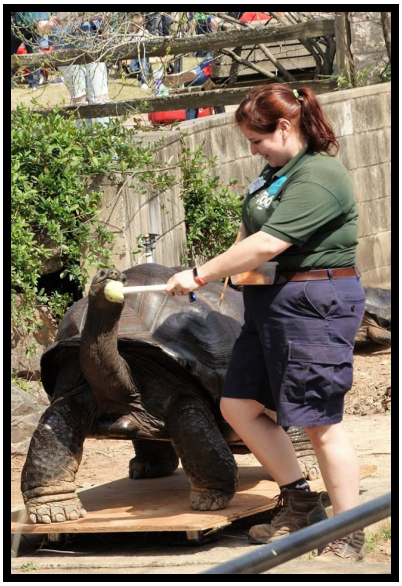


*Image 3 (below)*

*Image 4 (below)*



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Sticking it: Using Acupuncture in Large Carnivores

Abstract:

Acupuncture has been used widely to treat domestic cats and dogs for a variety of health issues. Denver Zoo has been successful in using acupuncture to help many of its residents including Sabi, a 6-year-old lion with bone deformities and Kelele, a 4-year-old spotted hyena with social anxieties. Due to poor nutrition as a cub, Sabi had stunted growth, metabolic bone disease, and has now developed early onset of arthritis. She receives supplements, injections, and medications to help with pain management and joint support. We were interested in finding innovative ways to help manage her pain without increasing her medications. Kelele is a male spotted hyena; he and two unrelated females came to Denver Zoo to be hand raised and eventually become our new breeding clan. As the three started to mature, the females naturally started to chase and discipline him. He started to show stress related behaviors, such as avoiding the females and refusing to shift inside. We tried acupuncture to reduce his stress and anxiety. We use an individualized approach to training and reinforcement during acupuncture sessions. Both participate voluntarily in 10-20 minute sessions twice a month. Sabi has a more structured food-based session with focused needle placement. Kelele has a more relaxed tactile-based reinforcement, where he will present areas for needling. We have seen positive results in both Sabi and Kelele. After acupuncture Sabi is very lethargic, sleeping soundly for all or most of the day. The days following, she is generally more excited, in a good mood, and will solicit more for attention from keepers. Since starting acupuncture with Sabi we have seen an increase in her interactions and playing with pride mates, and a decrease in days where she is stiff and sore. Kelele will also become more sedate after his sessions generally sleeping all day. We will manage him alone on those days to reduce the stress from the females and let the endorphins from the session keep him calm and relaxed. During the sessions he will often become tired, yawn, or stretch and we have been able to see some parasympathetic results as well. While we are not sure if acupuncture has had a significant impact on his social anxiety with the females, Kelele enjoys the personalized attention.

# Sticking it: Using acupuncture in large carnivores

Jordan Schimming and Katelyn Stache
Denver Zoological Foundation

Due to the wide use of acupuncture to treat a variety of health issues in domestic animals, the Denver Zoo has used acupuncture on many of its residents, including penguins, snakes, tortoises, lesser kudu, and okapi. Recently acupuncture has been used to treat two large carnivores: an adult female lion and a sub-adult male spotted hyena.

Sabi is a 6-year-old female lion who came to the Denver Zoo at the age of 4 months from Qatar. Her parents were a gift to the royal family. Her mother died shortly after giving birth to Sabi and her two brothers, leaving the family to hand raise the three lion cubs. During their time there, the cubs were fed boiled chicken, domestic cat kibble, and canned kitten food. When they arrived at the Denver Zoo, the cubs were underdeveloped for their age and below average weight. Due to her poor nutrition during development, Sabi was diagnosed with many medical issues including metabolic bone disease, arthritis, stunted growth, and bone deformities. Sabi's growth plates closed early, around 1 year old, making her significantly smaller than normal female lions. She weighs between 190-200 pounds as an adult. Her

right hind femur is 3+ cm shorter than her left, causing mobility issues. Sabi is being treated with glucosamine chondroitin and tramadol daily, and she receives Adequan (polysulfated glycosaminoglycan) injections twice a month to help with pain management and joint support.

Though Sabi is spayed, due to her small size and health, she lives as part of a breeding pride. When the pride had its first litter of cubs, Sabi participated heavily in helping care for them. She was seen frequently playing with the small cubs. However, as the cubs got older, larger, and much rowdier, Sabi began to withdraw from interactions with them. Keepers noticed significant changes in Sabi's behavior. She would not interact with the pride as often as she had been, and she was no longer soliciting to keepers for attention. Often, she was slow or unwilling to shift to inside holding, where space can be more limiting, and there was a decrease in her overall activity level. An increase of limping and stiff movement was also observed from Sabi. Knowing there would be a need to increase medications to keep Sabi comfortable throughout her life, keepers wanted to find alternative ways to manage Sabi's painful symptoms right now.

The way Sabi was trained and fed was modified. Keepers focused on an exercise plan for her, which included doing her basic behaviors but adding more repetition or duration to help strengthen her muscles. Alterations were also made to her training behaviors to accommodate some of her mobility limitations and making behaviors more comfortable for her. In addition to making training more positive for her, keepers also wanted to try acupuncture treatment with her for more pain relief. Positive results had been seen with this around the zoo and Sabi was a good candidate to try it.

Due to the excitement for food possibly overriding the effects of acupuncture treatment, keepers initially planned to train this without food as a reinforcement. Since Sabi is hand raised and will approach the front of the holding stall for keeper attention, it was thought that this would aid in her training. She was asked to come over and lay by the mesh for scratches using a bamboo back scratcher. This worked to start with, but the sessions were inconsistent. Sabi is very excitable with new people, and during some sessions, would take 20 minutes to settle down when she saw the acupuncturist. Sessions would also be highly dependent on if Sabi would come over for scratches or how long she would stay. Another factor in Sabi's participation rate depended on the female cub in the pride. The pride was rarely separated outside of short training sessions, so the young female would call to Sabi during this longer than normal separation period. This was distracting enough for Sabi to keep her from participation in treatment. During beginning stages of treatment, the acupuncturist was able to focus the needling on areas that would give high endorphin release and help build a positive association with acupuncture. However, she did not have great access to locations that would help Sabi with her pain. To get more consistent results, keepers decided to make it a formalized training session using food or frozen treats. The sessions were also moved to an area in the building with transfer ramps that people can access both sides of. Sabi was trained to lay down in a position where her back and hip are against one side of the ramp. From that position a trainer can be on one side reinforcing Sabi, while the acupuncturist and another trainer are on the other side needling her back and hips. The acupuncturist focuses the needles in the lower back and hips to treat hind limb pain and weakness. With the modifications made to how her sessions were conducted, Sabi now lays voluntarily for treatment for 15-20 minutes each session and allows for electrical stimulation.

Following acupuncture sessions, Sabi is very relaxed and lethargic, even for a lion. Since starting this treatment, positive physical and behavioral changes have been seen in Sabi. She has less days where she

is stiff, her activity level has increased, she is soliciting attention from keepers, and interacting and playing with the pride again. One of the effects that was not expected, was during a routine exam under anesthesia. The hope was to load Sabi's back and hips with needles and use electrical stimulation while she was sedated and have higher results. She was so relaxed from the acupuncture it took much longer for her to fully wake up and made reintroductions with the pride more difficult. For a solitary cat these lasting effects might be beneficial.

Moving forward, the plan with Sabi is to keep her at the lower end of her healthy weight, continue her twice a month Adequan injections, and twice a month acupuncture sessions. She will also continue with modified training to make her comfortable and build strength.

Kelele is a 4-year-old male spotted hyena. As a singleton needing to be hand raised, he was brought to Denver Zoo to be raised with two females who were also being hand raised. As the clan got older and started sexually maturing, we started to see stress behaviors from Kelele. Male hyenas' lives are typically stressful and they normally behave more nervously than the females. However, Kelele was showing more stress related behaviors that were turning into stereotypic behaviors than a normal male spotted hyena. He started to refuse to shift inside the holding areas and he was injuring himself running from the females. He had also started a head rolling behavior. There was little interaction between Kelele and the two female hyenas in the clan. Keepers started an observation log which noted everything that was going on around him while he was showing his stereotypic stress behaviors, such as: location, time, shifting, feeding, keepers present, and other species in the area in attempts to understand the cause of the stress. Overnight camera observations were also conducted to see if there was aggression from the females that keepers were not there to observe. More group and large carcass feedings were implemented alongside high value enrichment, with the hopes that it would strengthen the social bond between the group. Keepers started to limit shifting with the group and did a fission/fusion management style. There were very minimal positive results from everything that had been tried to reduce Kelele's stress at this point. Since acupuncture had been a success with Sabi, and acupuncture is used in humans and domestics for anxiety, keepers wanted to try it with Kelele.

Kelele is usually more motivated by keeper attention and interaction than he is with food, so we were able to use scratches with the back scratcher as his reinforcement during his acupuncture treatment. This allows him to not override the sessions with excitement over food and allows us to do multiple practice sessions in a day. Kelele's needles are focused in the forehead, ears, neck, and shoulders. These points help to calm him and give endorphin release. Kelele will come over to the mesh and present various parts of his body that he wants scratched and the acupuncturist can place needles. During some beginning acupuncture sessions, Kelele would get so relaxed and the parasympathetic responses would be so strong that he would vomit and then roll in it, ending the session early. To avoid this, keepers changed his feeding schedule temporarily, so that he did not receive whole prey items the day before his acupuncture sessions, which he typically vomited up the hair from. Other obstacles with him have been his interest in the needles, sometimes he likes to watch the needles go in and it distracts him from pressing his body against the mesh. Also, if the females in his clan make any noises, or there is shifting going on in the building, he can get nervous and will leave the session.

Some of the effects we have seen with Kelele during acupuncture are parasympathetic responses, such as yawning and nasal dripping. The sessions have a calming effect on him and he is very relaxed after. We also see high participation from him in sessions which indicates that he really enjoys acupuncture. However, these positive effects only last while he is housed alone. Any calm behavior seen from him is overridden when the females are given access back to him. Due to this, keepers usually leave him housed alone for most of the day or overnight following his treatment. Kelele's acupuncture sessions

normally last for 15 minutes with him voluntarily presenting different parts of his body at the mesh. The session ends when he starts to inspect something else in his area.

The plan for Kelele is to prioritize socialization of the group he is housed with. It would be more beneficial for him to learn to cope with living with the two females he is housed with and bond with them. Keepers will also continue to limit his stressors when possible and to continue acupuncture for now.

Safety is an important consideration when using acupuncture on large carnivores, both for the people and the animals. The acupuncturist modifies her methods of needle use while giving these individuals treatment. She uses longer needles to ensure no hands cross the plane of the mesh. Using a plastic tube to stabilize the needles when she is putting them in allows her to use longer needles properly. The acupuncturist also attaches the electrical stimulation clips to the ends of the needles, even while not using the machine, so if the animal walks away, the needles pull out and stay at the mesh instead of leaving with the animal. The choice to use acupuncture with Sabi and Kelele is only as a supplement. Sabi's pain is still being managed with medicine and husbandry changes. While Kelele's behavior is being worked with through housing modifications. Acupuncture is being used to assist both of these individuals with their separate needs and provide better wellness to both.

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## Alternative Strategies for Managing Diabetes in 1.2 Brown Capuchins (*Cebus apella*)

By: Ellen Vossekuil, Zoo Specialist and Tori Spinoso, Zoo Manager
Ochsner Park Zoo, Baraboo, WI

### Introduction

In the beginning of 2016, one of our female brown capuchins was formally diagnosed with diabetes. Staff followed an aggressive treatment regimen to stabilize her physical health. After two months, her health stabilized to the point where we switched to long-term care. Around that time, our male started showing clinical signs of diabetes as well. Staff decided to forgo daily insulin injections in favor of using a modified ketogenic diet and oral medication to manage both monkeys long-term. As of August of 2018, both animals are maintaining good health and welfare without the need for injectable insulin.

### Ochsner Park Zoo

OPZ is located in Baraboo, WI. The zoo covers less than three acres, and is run by the Parks and Recreation department of the City of Baraboo. The zoo has been in its current location since the late 1920's and has gone through several rounds of renovations. Currently, no building or exhibit on the site is older than 1990. Currently the zoo is home to 31 species and 60 individuals.

Historically, zoo staffing had been confined to one full-time Zoo Specialist and one part-time keeper position on weekends. Starting with the 2016 budget year, another full-time keeper position was added, creating a Zoo Manager position. The zoo also hosts interns in the spring, summer, and fall for 40-hours per week for 12-20 weeks per session.

### Individual history of Zephyr and Jose

Zephyr was born at Brookfield Zoo in Chicago, IL as part of the Brown Capuchin SSP. The diet of the entire troop followed AZA husbandry guidelines and was overseen by the zoo's veterinary department.

Brookfield was looking to place their remaining Brown Capuchins to make way for other primate species via SSP recommendations. Ochsner Park Zoo had just lost our male capuchin which left an older female as a solitary animal. Zephyr was transferred to Ochsner Park Zoo in June 2014 and introduced to Lana.

Jose came from a primate lab in South Carolina. He was housed as part of a multi-male, multi-female breeding group, and was involved in studies involving cognition and problem-solving. The diet of the troop was standard lab primate diet relying heavily on commercial biscuits and canned food with sporadic produce and protein sources for enrichment.

Jose was brought to Ochsner Park Zoo in September 2015 and introduced to Zephyr and Lana.

The historical diet of any capuchin troop at Ochsner Park Zoo consisted of a once per day feeding of free choice fruit and veggies, one can of Zupreme Primate Diet, and Mazuri primate biscuit. Insects, nuts, and other protein sources were used sporadically as enrichment items but were not part of the daily

diet. This diet resulted in the monkeys choosing to eat only the fruit and the canned diet, skewing their daily intake of calories with more sugar and carbohydrates than would be optimal for an omnivorous primate.

**Beginning of Clinical Signs and Diagnosis**

In December of 2015, staff noticed Zephyr appeared to be losing a significant amount of hair. Her weight had also dropped quickly with in the last few months. The contracted vet for Ochsner Park Zoo has limited primate experience, so staff contacted a veterinarian from the University of Wisconsin Primate Lab. On February 4, 2016 staff traveled to Lodi Veterinary Clinic to consult with Dr. Saverio Capuano (Dr. Buddy) from the UW Primate Lab. Zephyr was formerly diagnosed with diabetes based on blood tests and other clinical signs.

# Detailed Lab Results

| | | | |
|---|---|---|---|
| Patient: 185329 | Patient: Monkey (Zeph | Sex: Female | Age: 29 Yrs. 1 Mos |
| Client: 117660 Baraboo Parks Dep | Species: Canine | Breed: Mixed | Weight: 0.00 pounds |

Lab ID: INCLINIC IDEXX VetLab In-clinic Laboratory
Template: Chemistry
Staff: Mike Etter, DVM
Status: Posted
Req ID: 41722 - Thursday 2/4/2016 11:09:01

| Test | Results | | Reference Range | Low / Normal / High |
|---|---|---|---|---|
| ALB | = 4.4 g/dL | H | 2.2 - 3.9 | |
| ALKP | = 59 U/L | | 23 - 212 | |
| ALT | = 34 U/L | | 10 - 125 | |
| BUN/UREA | = 26 mg/dL | | 7 - 27 | |
| Ca | = 10.4 mg/dL | | 7.9 - 12.0 | |
| Chloride | = 123 mmol/L | H | 109 - 122 | |
| CHOL | = 261 mg/dL | | 110 - 320 | |
| CREA | = 0.6 mg/dL | | 0.5 - 1.8 | |
| GGT | = 95 U/L | H | 0 - 11 | |
| GLU | = 381 mg/dL | H | 70 - 143 | |
| PHOS | = 3.4 mg/dL | | 2.5 - 6.8 | |
| Potassium | = 3.6 mmol/L | | 3.5 - 5.8 | |
| Sodium | = 166 mmol/L | H | 144 - 160 | |
| TBIL | = 0.4 mg/dL | | 0.0 - 0.9 | |
| TP | = 7.6 g/dL | | 5.2 - 8.2 | |
| GLOB | = 3.2 g/dL | | 2.5 - 4.5 | |
| ALB/GLOB | = 1.4 | | | |
| BUN/CREA | = 43 | | | |
| Na/K | = 46 | | | |
| OSM calc | = 346 mmol/kg | | | |

Dipstick
Glucose 1000 +
Ketones 50 +
ph 6.5
Prot 100 +
S.g. - 1.048

# Detailed Lab Results

Patient: 185329 Patient: Monkey (Zeph Sex: Female Age: 29 Yrs. 1 Mos
Client: 117660 Baraboo Parks Dep Species: Canine Breed: Mixed Weight: 0.00 pounds

Lab ID: INCLINIC IDEXX VetLab In-clinic Laboratory
Template: Hematology
Staff: Mike Etter, DVM
Status: Posted
Req ID: 41722 - Thursday 2/4/2016 11:01:50

| Test | Results | | Reference Range | Low Normal High |
|---|---|---|---|---|
| HCT | = 42.5 % | | 37.3 - 61.7 | |
| HGB | = 13.3 g/dL | | 13.1 - 20.5 | |
| MCHC | = 31.3 g/dL | L | 32.0 - 37.9 | |
| WBC | = 8.21 K/uL | | 5.05 - 16.76 | |
| LYMPHS | = 1.03 K/uL | L | 1.05 - 5.10 | |
| %LYMPHS | = 12.5 % | | | |
| MONOS | = 0.32 K/uL | | 0.16 - 1.12 | |
| %MONOS | = 3.9 % | | | |
| NEUT | = 6.82 K/uL | | 2.95 - 11.64 | |
| %NEUT | = 83.1 % | | | |
| EOS | = 0.01 K/uL | L | 0.06 - 1.23 | |
| %EOS | = 0.1 % | | | |
| BASO | = 0.03 K/uL | | 0.00 - 0.10 | |
| %BASO | = 0.4 % | | | |
| PLT | * * 475 K/uL | | 148 - 484 | |
| Retics | = 92.0 K/uL | | 10.0 - 110.0 | |
| %Retics | = 1.6 % | | | |
| RBC | = 5.82 M/uL | | 5.65 - 8.87 | |
| MCV | = 73.0 fL | | 61.6 - 73.5 | |
| MCH | = 22.9 pg | | 21.2 - 25.9 | |
| RDW | = 20.0 % | | 13.6 - 21.7 | |
| MPV | - --.-- fL | | 8.7 - 13.2 | |
| PDW | - --.-- fL | | 9.1 - 19.4 | |
| PCT | - --.-- % | | 0.14 - 0.46 | |

**Initial Treatment**

As soon as Zephyr returned from the vet examination, she was immediately put in to a small squeeze cage in capuchin holding. Zephyr remained in visual and auditory contact with Jose and Lana to alleviate some of the stress associated with her new situation. The capuchin off-exhibit caging at the time had limited capacity to separate animals, and no options for squeeze or partial restraint. Her health status at that point was dire; the choices were to start insulin treatments immediately or consider euthanasia.

Initial treatment required blood tests three times per day and insulin injections one or two times per day. The process for each treatment started with squeezing Zephyr up to the front of the cage. Because the cages are meant for larger-bodied macaques, keepers also had to create dividers to push Zephyr in to one corner of the front of the squeeze cage.

A lancet was used to prick the skin for blood testing. Staff ended up having the most success with taking blood from the tail for this process. A standard human blood tester with disposable strips was used. The challenge was getting enough blood for the test to read accurately. There was a learning curve for staff in efficiency and technique, especially with an animal who was not a willing participant.

Insulin injections needed to be given sub-cutaneous, which required keepers to pinch an area of skin up. This also proved challenging with an animal that was small enough to move no matter how tight the squeeze. This entire process initially required two keepers and took between ten and twenty minutes per session, three times a day. At the highest dosage, Zephyr was receiving 18 units of Lantis (glargine), a long-acting form of insulin.

In addition to the medical treatment, Zephyr underwent an immediate diet change. High-sugar fruits were eliminated from the diet, and her daily food intake was divided in to four “meals”. Each meal was weighed and consumption recorded.

DATE:

**Zephyr's Diet Sheet**

| | Sunday | Monday | Tuesday | Wed | Thur | Friday | Sat. |
|---|---|---|---|---|---|---|---|
| **AM Diet** | | | | | | | |
| Nuts | | | | | | | |
| Egg | | | | | | | |
| Onion | | | | | | | |
| Peppers | | | | | | | |
| Zoo Preem | | | | | | | |
| | | | | | | | |
| **10AM Diet** | | | | | | | |
| Peppers | | | | | | | |
| Avocado | | | | | | | |
| Broccoli | | | | | | | |
| Carrots | | | | | | | |
| Nuts | | | | | | | |
| Zoo Preem | | | | | | | |
| Sweet potatoes | | | | | | | |
| | | | | | | | |
| **PM Snack** | | | | | | | |
| Onions | | | | | | | |
| Tomatos | | | | | | | |
| Egg | | | | | | | |
| | | | | | | | |
| **Training treats** | | | | | | | |
| Super worms | | | | | | | |
| Dubia roaches | | | | | | | |
| Crickets | | | | | | | |
| Wax worms | | | | | | | |

Keepers were feeding Zephyr four separate meals per day, providing enrichment twice a day, and taking urine glucose readings opportunistically, in addition to the actual insulin treatments. This was on top of all the other husbandry and grounds-work duties required of the small staff. The result was keepers coming in early or late at night, coming in on their days off, and even our recently retired keeper coming back in to help with treatments for eight weeks. While keepers were happy to do whatever necessary to get Zephyr healthy, this aggressive treatment plan was not sustainable long-term.

After eight weeks of treatments, there were obvious improvements in Zephyr's overall health. Her weight had gone up to a healthy level and seemed to stabilize, and her hair had started to grow back. Furthermore, her energy level and strength had returned, making it increasingly difficult to squeeze her down for blood tests and insulin injections. It was time to decide how to manage Zephyr long-term.

Staff were in agreement that keeping Zephyr separated from the other animals in a small squeeze cage long-term was not acceptable welfare. The decision was made to put her back in with the troop on April 5th, 2016. The challenge would become how to manage her clinical health in a scenario where we would be unable to reliably deliver treatment.

**Veterinary-Recommended Treatment Plan**

The ideal clinical treatment for diabetic non-human primates is daily blood testing and insulin injections based on current blood glucose readings. This either requires daily manual restraint of the animal, or an animal that is trained to willingly accept blood testing and injections on a daily basis. Both of the full-time keepers had some experience with primates trained for voluntary diabetes management, but this was mainly with chimps who had been receiving treatment for years.

Keepers consulted with Dr. Buddy on what he would like to see as far as daily blood testing and insulin. His recommendation was to do twice-daily blood tests and once-daily insulin injections.

**Challenges and Adaptations**

While keepers were planning for the ideal scenario, they were also realistic in how feasible it was going to be in application. Three main challenges were compliance, caging, and zoo staffing.

*Compliance*: Zephyr's transfer paperwork had indicated that she was never incredibly engaged in training sessions at her previous zoo, and this had proven to be the case at OPZ as well. Pair an unenthusiastic participant with a very unpleasant behavior that she had been forcibly exposed to for the last eight weeks, and the end result was a consensus that the voluntary injection behavior would take a long period of time with intensive training to accomplish.

*Caging*: As previously stated, the capuchin holding at the time had no capability for restraint, and would have been costly and complicated to retrofit. Staff had installed a small wire squeeze cage inside the larger holding area, but it would require Zephyr to voluntarily enter the "crate" to allow her to be squeezed down. Staff did put in a budget request for new caging to be installed, which was approved. However, the soonest the caging could be put in was in three months.

*Staffing*: Zoo hours change significantly between the winter and the summer. Summer hours often require periods of time where the only staff at the zoo are interns. The eventual goal would be for Zephyr to accept injections from any trained staff member, but the initial training would only be done by the full-time staff. Consistency and trust-building were going to be an issue.

While staff were willing to try and had the skills to implement the training, they quickly realized that there would have to be some kind of intermediate scenario. The gap between daily insulin injections in the squeeze cage and the weeks or possibly months it would take to train Zephyr to accept treatment voluntarily needed to be bridged. So the decision was made to use dietary control and oral medications to try and control the diabetes symptoms.

**Diet Research**

*Ketogenic Diet as a strategy for Diabetes Management*

The basic idea of a ketogenic diet is to deprive the body of carbohydrates to the point that it switches over to burning fat as its main source of energy. The process of burning fat produces ketones. The state of fat-burning is called ketosis. In order to maintain ketosis in humans, a daily limit of 50g of

carbohydrates is recommended. Depending on personal body chemistry and activity level, that number may be as high as 80g and as low as 20g. The goal is to keep available carbohydrates low enough that the body uses fat, not glucose, as an energy source.

Ketogenic diets were first used to clinically treat seizure disorders in humans. Seizure patient s that were resistant to medications were put on a strict diet that eliminated all carbohydrates; the upper limit was 20 grams per day. The mechanism of how ketones specifically lower seizure rates is still unknown, but there was a period of time where a ketogenic diet was the first and best option for many patients with seizure disorders. As seizure medications become more effective and had fewer side effects, the ketogenic diet was pushed down to a third-tier treatment until it was resurrected in the 1990's by a popular news story about the son of a Hollywood director who "cured" his seizures with the diet. From there it morphed into a weight loss diet, with variations including Atkins and South Beach.

The original ketogenic diet focused on getting the majority of daily calories from fat, with less attention to protein levels. Ketogenic diet for weight loss and other health concerns is a low carbohydrate, high fat, moderate protein plan. The percentages of these macronutrients are generally around 70% calories from fat, 25% from protein, and 5% from carbohydrates.

Traditional treatment and management of type 2 diabetes has focused on lowering blood sugar over-all, with a focus on avoiding spikes and drops in blood sugar. This can be accomplished with diet, but additional insulin is still needed to actually break down the blood sugar that remains. It is a delicate balance; too much insulin and not enough blood sugar, and the animal can have a hypoglycemic incident.

Using a ketogenic diet to manage diabetes in humans works off of the idea that instead of doing a delicate balancing act with blood sugar, it is removed entirely from the equation. The only organ that requires any glucose at all to function is the brain. All other cells in the human body can run off of ketones for energy. It should be noted that this diet is NOT recommended for Type 1 diabetics, as ketosis can quickly become ketoacidosis, which is a life-threatening condition. However, there has been increased interest in using a ketogenic diet to manage and even reverse Type 2 diabetes in humans. (2) (3)

Using this general knowledge of "keto" and how it effects blood sugar, we decided to use these principles to guide our treatment plan for Zephyr. Obviously the mechanism of "diabetes" varies widely in taxa and in species. However, we were "lucky" that capuchins, being omnivorous non-human primates, have a lot of similarities to humans in their digestive system and metabolism. Many diseases and illnesses are treated in non-human primates with the same medications as humans. Old World non-human primates have been used as a model for Type 2 diabetes in research, due to the fact that several species naturally develop the disease in the same way as humans. (1) In consulting with the primate vet, we had no reason to believe that the differences between humans and capuchins would be so great that our ketogenic diet would harm them.

**Dietary Changes**

The diet of the capuchin troop (1.2 at the time) was altered drastically. Instead of one meal per day heavy with fruit, the diet was split into three meals: breakfast, lunch, and PM. The bulk of calories in the overall diet should come from fat and protein, with minimal carbohydrates.

Staff first eliminated almost all fruits from their diet, and switched their chow from Mazuri Monkey Chow to Mazuri Low Starch 5M1G. Several vegetables were also eliminated from their diet, specifically potatoes, yams, carrots, and beetroot. In order to judge which produce to eliminate, keepers looked at three different measures – net carbohydrates per 100g (net carbs = total carbs – fiber), glycemic index, and grams of sugar. From this chart staff produced a list of “approved produce” and “do not feed”.

| Food Item | Amount | Sugars | Net Carbs | Glycemic Index |
|---|---|---|---|---|
| Spinach | 100g | 0.4g | 1.1g | 15 (low) |
| Collard Greens | 100g | 0.5g | 1.0g | (low) sub-20 |
| Turnip Greens | 100g | 0.5g | 0.9g | (low) sub-20 |
| Bok Choy C | 100g | 0.8g | 1.2g | (low) sub-20 |
| Kale | 100g | 1.1g | | |
| Swiss Chard | 100g | 1.3g | 2.0g | |
| Lime | 100g | 1.7g | 8.0g | (low) |
| Lemon | 100g | 2.5g | 6.0g | (low) |
| Cranberries | 1 cup | 4.0g | 7.0g | (low) |
| Tomato-Cherry | 10 pieces | 4.6g | 4.0g | 15 (low) |
| Avocado | 100g | 1.9g | 2.0g | N/A |
| Artichoke | 100g | 1.0g | 6.0g | 15 (low) |
| Asparagus | 100g | 2.0g | 2.0g | 14 (low) |
| Brussels Sprouts | 100g | 2.2g | 5.0g | (low) sub-20 |
| Broccoli | 100g | 1.7g | 3.4g | 10 (low) |
| Cabbage | 100g | 3.2g | 3.5g | 10 (low) |
| Cauliflower | 100g | 1.9g | 3.0g | 15 (low) |
| Cucumber | 100g | 1.7g | 3.0g | (low) sub-20 |
| Eggplant | 100g | 3.5g | 3.0g | 15 (low) |
| Fennel | 100g | | 3.0g | (low) sub-20 |
| Green Pepper | 100g | 2.4g | 3.0g | 10 (low) |
| Green Beans | 100g | 3.3g | 3.5g | 14 (low) |
| Garlic | 1 clove (3g) | 0.0g | 1.1g | (low) |
| Mushroom | 100g | 2.3g | 2.0g | 10 (low) |
| Okra | 100g | 1.5g | 3.5g | 3 (very low) |
| Radish | 100g | 1.9g | 1.8g | (very low) |
| Scallions | 100g | 2.3g | 4.4g | (low) |
| Snap Peas | 10 pods | 1.4g | 7.5g | 15 (low) |
| Summer Squash | 100g | 2.2g | 2.3g | 15 (low) |
| Zucchini | 100g | 2.5g | 2.1g | 15 (low) |

# APPROVED PRODUCE FOR CAPUCHINS

**VEGETABLES**

Artichoke
Broccoli
Cauliflower
Cabbage
Brussels Sprouts
Asparagus
Fennel
Cucumber
Mushrooms
Tomatoes
Radishes
Zucchini/Squashes (summer)
Green Pepper
Red/Orange/Yellow pepper
Okra
Eggplant
Avocado/Guacamole (check ingredients for added sugar)
Green Beans
Garlic
Radish
Scallions/Green onions
Snap Peas

**GREENS**

Spinach
Kale
Bok Choy
All lettuces (iceberg, romaine, red/green leaf)
Arugula
Collard Greens
Swiss Chard
Leaks
Celery

**DO NOT FEED**

All fruits
Potatoes of any kind
Corn
Sweet Potatoes/Yams
Carrots
Red/Yellow/White onions
Winter Squashes (butternut, etc)
Peas
Beans
Grains (bread, oatmeal, rice, etc)

**Once Per Week**

Lemon
Lime
Sweet Corn
Carrot
2 Blueberries/blackberries
1 small strawberry
2 Cranberries
White/Red Onion

**Protein Items:**

Hard Boiled egg
Scrambled egg
Cheese cube
2 pinkie mice
Nut butters (low sugar PB, sunbutter, almond butter, etc)
Protein “shake” (powder with water/cream)
No-sugar yogurt
Cream Cheese

Once the produce changed, staff then looked at increasing fats and protein. Timing of food items was also discussed. The initial diet was as follows:

Breakfast: One protein item per animal, free choice high-fiber greens

Lunch: Commercial diet – Zupreme canned diet and Mazuri biscuits

PM: Free choice produce from the approved list, plus avocado or fatty nuts

The rational was to "break their fast" in the morning with calories from protein and fat, as well fiber and water intake. A side effect of eliminating carbohydrates from the diet is that the body releases more water. Water consumption is especially important to overall health on a low-carb diet.

To increase variety in the monkey's diet, keepers compiled a list of approved "Protein Items" that can be given based on availability and the monkeys' preferences. This list includes eggs, nuts, meat products, and dairy items, specifically cheese and cream cheese. The most frequent items given are cooked eggs (either scrambled or hard-boiled) and nuts. Insects are also given freely when available, but are not purchased reliably enough to make them a staple diet item.

The most "carby" part of the diet comes in the form of the commercially prepared diet. The base ingredient of Zupreme Primate Diet is soy, which is generally avoided on the keto diet as it is high in carbohydrates. This is the part of the diet staff did some experimenting with; eliminating canned and only giving biscuits, eliminating biscuits and only giving canned, and doing both. It was found that removing the canned food from the overall diet lead to Zephyr not ingesting enough calories through the day. By feeding this portion of the diet in the late morning, before their most active part of the day, they have the chance to "burn off" the carbohydrates they are ingesting with that meal.

PM diet is fed between 3:00 PM and 5:00 PM (depending on the season and when the zoo closes). Free choice produce is available from that time overnight. In reality, the favorite produce (read, most sugar) is eaten right away, and the other times are ingested in the next few hours. Once in a while, the monkeys will still be snacking on produce the next morning, especially if the keeper is slightly late with breakfast. The fat item is given at this time to "tide them over" until the next morning.

**Vitamins and Supplements**:

A daily vitamin was recommended by the vet to cover any gaps in nutrients that may have occurred in the new diet. Animal Parade Gold (with xylitol) is a children's sugar-free vitamin. 1/3 of a vitamin is given daily to each monkey.

Keepers also researched several naturopathic supplements with studies showing their positive effects on blood sugar. One in particular was purchased, but it tasted so terrible that it was never reliably ingested by the animals.

**Oral Medications**

While Zephyr was being diagnosed and treated for diabetes, our male Jose was also starting to show traces of glucose in his urine when tested. During the winter, he would also take on a "wet" appearance. We later realized that this was due to a normal capuchin behavior of urine washing. The sugar in his urine was drying on his fur, leaving it clumped and sticky. Consulting with the primate vet, we decided to also put Jose on oral diabetes medication, with a "can't hurt, might help" mentality.

The two medications prescribed by the vet were metformin and glipizide. Metformin is a member of a class of drugs called biguanides that helps lower blood glucose levels by improving the way the body handles insulin — namely, by preventing the liver from making excess glucose and by making muscle and fat cells more sensitive to available insulin. Glipizide is an oral medicine that helps control blood sugar levels by helping the pancreas produce insulin. If the body is still producing any insulin at all, these drugs in tandem will increase production of insulin, while reducing glucose production and making cells more sensitive to the available insulin.

Medications are given once per day. Glipizide is given without any food, and metformin is given half an hour later with "breakfast". Both medications are usually given in sugar-free jelly or no-sugar-added peanut butter, as these are the only reliable substances that mask the bitter taste of the metformin.

**Increased Exercise**

In tandem with the diet change and medications, staff made some lifestyle changes for the capuchin troop to encourage as much activity as possible. If the monkeys could "burn off" the extra glucose in their bodies, it would have less of a detrimental effect on their overall health.

*Perching*: Both on exhibit and in holding, perching was changed from static to movable. Branches and wooden shelves were replaced with fire hose, hanging swings and hammocks, and more flexible platforms made out of plastic bread trays. There were still options for the monkeys to sit on stable platforms, but the majority of their travel and resting required more physical activity and balance.

*Feeding Strategies*: Scatter-feeding has been shown to increase activity in non-human primates, but several factors of the OPZ exhibit made this solution less than ideal. Staff started looking at how to increase physical activity during feeding times in other ways. Feeders and buckets were hung close to the floor or high on exhibit to encourage the monkeys to climb between the food location and their preferred "eating spot". Two meals a day are required to be given in puzzle feeders to increase forage time and physical effort in getting to the food.

*Enrichment Focus*: The previous focus for capuchins had been to stimulate them mentally more than physically. Which this is obviously still an important goal, the individual animals at OPZ are all older and in a stable social group. The enrichment focus was changed to encourage physical activity; items that required problem-solving but very little movement were given less often than items that required physical exertion. If an item required both problem-solving and physical activity, it was put in rotation more often.

*Training*: The focus of training sessions initially was voluntary squeeze and voluntary injection while in holding. However, when staff did training sessions outside, the focus became on movement, specifically having the monkeys follow their targets large distances to encourage climbing and balance.

**Setting Zephyr "Free"**

On April 5th, 2016, Zephyr was released in to one unit of the capuchin holding, still separated from Jose and Lana. As staff suspected, blood tests and insulin injections stopped immediately as there was no way to administer them. Urine was collected daily to continue to test urine glucose and ketone levels. Training in the temporary squeeze cage also commenced. Zephyr would readily enter the cage, but would not allow any restraint.

On April 9th, 2016 Zephyr was reunited with Jose and Lana and had full run of all capuchin exhibit and holding areas. Staff would separate her each morning in order to collect urine for daily testing and to continue squeeze-training. This continued for several weeks. Urine glucose readings had stabilized and no ketones had been detected, so staff decided to forgo daily testing and switch to opportunistic testing and voluntary urination behavior.

**Assessment: Is this working?**

Because there was no longer any blood testing numbers available for health assessment, staff created their own list of assessment criteria to help gauge over-all quality of life. The conversation started by asking some general questions:

How would we know if Zephyr was "sick"?
What does "sick" look like?
What does a "good day" look like?
What things would we be worried about if we saw them?
How "bad" would we allow her to get before intervening again?

The assessment categories staff created included:

*Urine Glucose and Ketone Readings*: Urine was tested opportunistically for glucose and ketones using dip-strips purchased at the local pharmacy. Some training for voluntary urination was attempted, and Jose proved excellent at peeing on command. It is expected that urine glucose will be detected, but it is considered "good" if ketones read zero (an indication that no ketoacidosis is happening). Zephyr's urine glucose readings are generally between 250 and 1000, depending on the time of day the urine is collected.

*Body Weight*: One of the most obvious indications that Zephyr was ill was a steep drop in body weight. Zephyr was weighed weekly at first, but currently is weighed monthly.

*Coat Quality*: The other major sign of initial illness was hair loss, especially over the winter months. Some hair loss is still experienced in January and February of 2017 and 2018, but it was in small patches

and recovered quickly when the monkeys were able to spend more time outside. Sticky fur is another indication of lots of sugar in the urine. Staff saw sticky fur the winter of 2017, and increased the opportunity for physical activity shortly thereafter. Sticky fur was seen only sporadically in winter 2018 and is never seen in summer or fall.

*Activity Levels*: Staff looks for Zephyr acting "tired" at odd times, such as "getting out of bed" later than normal in the morning, or being unwilling to come over to keepers when they do afternoon checks or training sessions.

*Appetite and Food Consumption:* A lack of interest in food would be a major indicator that Zephyr is not feeling well, as she is consistently interested in food and willing to work at difficult puzzle feeders to obtain it.

**Adaptions to The Plan**

The original goal of the lifestyle changes was initially just to bridge the gap between periods of providing injectable insulin. Body target training was started immediately, in preparation for sub-cutaneous injections. In late July of 2016, new caging was installed in capuchin holding, complete with a chute system and built-in squeeze. Training was started with restraint and squeezing in the chute shortly after.

Progress was made with Zephyr allowing herself to be closed in to the chute and partially squeezed down without distress. However, progress came to a screeching halt any time she caught a glimpse of a needle, or anything resembling a needle shape. Several strategies were attempted with no progress and a break-down of the chute behavior.

At this point, it had been about six months since insulin injections had stopped completely. Given the challenges encountered in voluntary injection training, it was time to re-assess.

Staff looked at the welfare indicator list and had several conversations about Zephyr's status. Her weight had stabilized and had not gone back down in the last six months, and her hair had grown back in. Urine readings consistently showed moderate levels of glucose and no ketones. Her activity level and appetite seemed fine. She was taking her oral meds pretty consistently. The current plan seemed to be keeping her health stable enough for a good quality of life. The decision was made to officially stop injection training and keep doing assessments every six months or as needed.

Winter 2016-2017: Staff started to see more hair loss and sticky fur in January of 2017. Adjustments were made to holding areas and feeding strategies to increase activity levels, and monkeys were given outside access any time the temperature was over 30 degrees F and sunny. The rationale was that the lack of physical activity was keeping the monkeys from working off the extra sugars. By late March of 2017, Zephyr's hair had grown back in and no more sticky urine was seen.

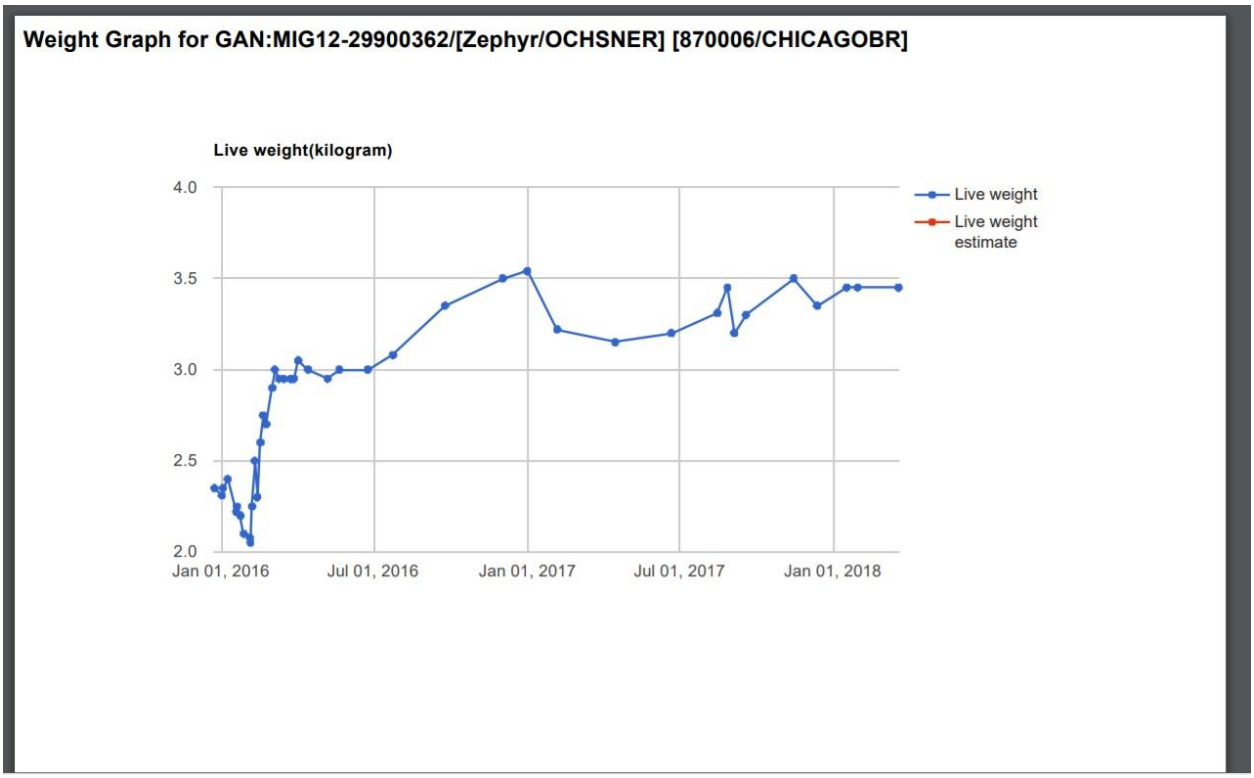
Summer 2017: In late August of 2017, Lana (0.1) passed away from age-related health complications. She was the only animal in the troop who had not been diagnosed or treated for diabetes, but had

benefited from the diet change and increase physical activity. The “troop” was now Jose and Zephyr as a 1.1 pair.

Winter 2017-2018: December and January were extremely cold months, which prevented the capuchins from having outside access for six solid weeks. Staff tried to compensate with more activities and foraging opportunities in their “window exhibit”, a small unheated room adjacent to their holding area. Zephyr did enjoy foraging for nuts and bugs in bark, straw, or shavings, but both monkeys still preferred to spend their days in their holding area. Staff did note that Zephyr experienced far less hair loss and sticky fur this winter when compared to last winter.

Summer 2018: Zephyr and Jose experienced a bit of an upheaval socially when a new exhibit opened next door and a pair of river otters moved in. While both animals exhibited some stress behaviors, their health remained steady for the entire summer.

**Current Status and Future Plans**




It has been two years and eight months since Zephyr was diagnosed with diabetes, and two years and six months since she went off injectable insulin. Her health and welfare has remained relatively steady over that time period with a few adjustments to her lifestyle and diet. Currently both Jose and Zephyr take their oral medications once per day and remain on a diet heavy in protein, fat, and fiber and low in overall carbohydrates.

For the future, staff still plan on assessing Zephyr every six month to make sure her welfare is still acceptable. After looking at the assessments from the last two years, it is clear that winter usually

causes a down-turn in Zephyr's health. While she has never gotten ill enough to repeat the aggressive treatment needed initially, there appears to be something about winter in Wisconsin that changes the effectiveness of the diet and medication. Staff have discussed the possible factors with both the contracted vet and the Primate Lab vet, and how to combat those effects for winter 2018-2019.

One factor is a lack of physical activity. The holding area and inside exhibit areas combined are only half as large as their outdoor enclosure. Changes in Zephyr's health do not usually start to happen until the monkeys are confined inside due to extreme cold temperatures. However, the holding area is consistently heated to 78 degrees in the winter, so cold temperatures alone should not have any effect on their health. Staff already saw an improvement in January 2017 when they increased opportunities for physical activity, and this is an area to explore for the coming winter.

The other factor brought up by the vet may be natural light. The holding area does have large windows, but the glass is likely blocking some of the UV rays. Combined with the shorter days of Wisconsin winter (where it gets dark at 4:30PM), and this lack of UV may be effecting coat health and metabolism, which is a known issue in many New World primate species. While the UV light may not have a direct effect on diabetes, it may be effecting overall health or causing some of the hair loss. Staff are exploring the option of supplemental UV lighting for the winter months to see if this makes a positive impact.

A third strategy staff are currently exploring involves the concept of Intermittent Fasting. Intermittent Fasting is an eating strategy in which "meals" are only eaten in a small window of time in a 24 hour period. This is known as "time-restricted fasting". For example, a 20/4 IM schedule has 20 hours of fasting and four hours during which food is consumed. There have been some exploratory studies that suggest that intermittent fasting may actually help reverse type 2 diabetes by helping the pancreas to work more efficiently. (4) Because Zephyr and Jose are not taking supplemental insulin, there is little risk of hypoglycemic episodes with fasting. Keepers are currently discussing possible fasting schedules and how that would coincide with diet compliance and overall zoo schedules.

**Conclusions**

Managing Zephyr's diabetes has been a challenge in logistics, teamwork, and welfare assessment. The complicated factors that made the standard diabetes treatment unfeasible pushed zoo staff to think outside the box. Keepers had to balance Zephyr's physical health with her overall quality of life, including social and emotional well-being. The current strategy has been working well for over two years, and Ochsner Park Zoo staff is dedicated to future assessment and adjustment as needed to keep Zephyr's quality of life high.

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# Guts, Hides, and Bones- Making Diets More "Real" for Tigers

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**Abstract**
All three Sumatran tigers at the Downtown Aquarium Denver have been diagnosed with inflammatory bowel disease (IBD). Over the course of several years a combination of pharmaceutical treatments and diet manipulations have been implemented with minimal success. This lack of success has promulgated a transition from a traditional tiger diet to a more progressive "naturalistic" diet. Most animal care professionals are familiar with the different brands of processed meats designed to provide a balanced diet for the animals in their care. Along with these processed diets many animal health programs require that an animal's diet is to be supplemented with natural food items.

Providing a more naturalistic diet require having access to several types of meat, along with having access to the organs, bones, and hides. We worked with a local meat processor to source elk, deer, rabbit, antelope, lamb, turkey, and chicken. Horse, beef, and pork were sourced from known zoo carnivore diet producers.

This variety provided us a wide variety of meat products that allowed us to create a substantial diet variance. After a year and a half of a new diet being implemented, the tigers' behavior was observed to have improved. The trainers observed greater activity levels with an increased participation in training sessions. Aside from behavioral changes, each animal showed gradual weight gains. Symptoms of IBD, (i.e., frequent vomiting and diarrhea) decreased and all three tigers were eventually weaned off their prescribed medications. This technical note may provide some insight for other captive animal management programs on the benefits of changing diet plans of large carnivores.

**Introduction**
In the animal care field, animal welfare standards and procedures are continually evolving. These standards and procedures include the management of an animal's diet and subsequent nutrition. When animal diets are being formulated many aspects are considered. Feeding ecology and the natural history should be considered in order to make sure that species-specific feeding patterns and behaviors are stimulated (Tiger Care Manual, 2016). Most animal care professionals are familiar with commercially produced diets, typically coming in the form of a ground-up meat base with additives. These commercial diets are formulated to make sure all nutritional needs are met. Commercially produced diets have been used for large carnivores of the zoo/aquarium industry for many years, but they do not fall under the category of naturalistic, and can even minimize the species typical behaviors regarding feeding (Tiger Care Manual, 2016). In their native habitat, tigers eat a variety of animals including wild pigs, cattle, and deer (Tiger Care Manual, 2016). In the wild a tiger would have to bite through an animal's fur/skin, use their carnassial teeth to shear tissue, and jaw muscles to crack bone.

It is well documented that poor diets contribute to medical issues. Because large carnivores depend on high protein content, it is difficult to ensure they are getting everything they need nutritionally (Lane, Miller, Lobetti, Caldwell, Bertschinger, Burrough, Kotze, Van Dyk, 2011). Two of these medical issues are Inflammatory Bowel Disease (IBD), which affects the entire intestinal tract, and gastritis, which is more localized to the stomach. Symptoms of both diseases include chronic vomiting, presence of undigested meat in feces, weight loss, dull hair coat, anorexia, and chronic diarrhea (Whitehouse-Tedd, Lefebvre, Janssens, 2015). There is a growing understanding about the causes that contribute to the development of IBD and gastritis in exotic felids, especially cheetahs. Recent research has linked IBD and gastritis to diet and chronic stress (Whitehouse-Tedd, et al., 2015). Specifically horse and goat meat have been linked with the increase in gastritis and vomiting. Unfortunately most commercially available large carnivore diets are horse based products (Whitehouse-Tedd, et al., 2015).

Aside from feeding live prey, providing the entire carcass of a prey item is the easiest method to replicating a naturalistic diet for large carnivores. In a dietary study of large carnivores with IBD, the feeding of muscle meat and whole carcasses showed an improved gastrointestinal health status as compared to animals that were fed a commercially produced diet (Whitehouse-Tedd, et al., 2015). This study also showed that while being fed carcass

components (i.e., ribs and long bones) the occurrences of vomit and diarrhea were less likely to occur (Whitehouse-Tedd, et al., 2015). It concluded that carnivores fed the muscle meat had a reduced risk of gastritis and an overall improvement in fecal consistency, as compared to a commercially produced meat products. (Whitehouse-Tedd, et al., 2015).

This paper will discuss the management of IBD in three Sumatran tigers, the treatments implemented for this medical condition, and the eventual transition from a strictly commercially produced diet to a more naturalistic diet plan.

**History of our cats**

The Downtown Aquarium Denver houses 3.0 Sumatran Tigers (*Panthera tigris sumatrae*) Jalan, Besar, and Marah. In 2010, all three tigers began to exhibit the following symptoms: lethargy, lack of motivation for training sessions, loose stools, un-digested meat in stools, vomiting, weight loss, and decreased appetite. All three were started on prednisolone and omeprazole for suspected inflammatory bowel disease (IBD). The diet at this time was Nebraska brand horse feline diet and Triple A horse chunk meat. In conjunction with starting medication, the management team added different items to the daily diet. Triple A was replaced with chicken for two reasons. One reason was that the new diet item might be more motivating for the tigers. Secondly, chicken was selected because it was suggested that it reduced the odds of developing gastritis (Whitehouse-Tedd, et al., 2015). Unfortunately, the symptoms never decreased and chicken was subsequently removed as a diet item.

From 2010 through 2013 various doses and combinations of medications were prescribed. Prednisolone, omeprazole, and amoxicillin were used to treat the IBD "flare-ups" in all tigers. Fortiflora and famotidine were also introduced in to the treatments with little to no change in symptoms. In the spring of 2013, Jalan was selected to undergo an endoscopy procedure to confirm the diagnosis of inflammatory bowel disease. During this procedure the veterinarian identified the presence of ulcers in the stomach and intestines. Ultrasounds were performed on Besar and Marah which identified a thickening of the intestinal walls, confirmed inflammatory bowel disease. After these observations the veterinarian suggested managing the animals behaviorally in an attempt to reduce stress, along with changing their diets to a more bland protein. Medication changes were continually made with the additions of carafate, tylosin, clavamox, sulcralfate, metronidazole, budesonide, and metamucil.

In 2014 an experimental stem cell procedure that had been successful in domestic house cats with IBD was implemented. The procedure required stem cells to be harvested from one of the tigers, then propagated in a laboratory. Once propagated, the cells were to be injected into all three of the tigers. The difference in this trial was that with house cats the stem cells were harvested from a healthy cat and then injected in to an IBD animal. The IBD domestic cats also received IV injections every two weeks after the initial treatment. Due to some clinical complications in handling the stem cell cultures, the treatment was done slightly different, and showed no positive results. Future modifications are still being discussed, but for the short term the procedures were discontinued.

In 2015, the tigers were offered a commercial product Carnivore Essentials (pork), but were still fed the Nebraska brand horse loin as the main training diet. We were hopeful that the bland diet would provide the needed gastrointestinal reset. Again, no immediate changes were seen. Unfortunately in 2016, the Carnivore Essentials pork product no longer was available, requiring us to return to previous food types.

In 2016 Jalan and Besar were placed under anesthesia in another attempt to administer the healthy propagated stem cells. Although no improvements were seen as a result of this treatment, blood was taken to run additional tests including a gastrointestinal panel. The panel indicated that there was the possibility of exocrine pancreatic insufficiency in addition to low cobalamin levels. Both of these parameters could indicate abnormal GI bacteria as is seen in domestic cats. The recommendation was to try feeding them pancreas to provide pancreatic enzyme and offer probiotic supplementation. However all of these results were in comparison to domestic cats and six months later, after comparing the values that suggested abnormal GI bacteria and exocrine pancreatic insufficiency to healthy tigers, it was found they were species specific and not nearly concerning as previously thought. The cobalamin was still low in comparison to healthy tigers. Cobalamin supplements were attempted with no changes in symptoms.

**Research**

In 2016, after all the failed treatments, the team developed a new approach to feeding the tigers. We looked at what a tiger would eat in the wild, imagining that the kill could be a hoof stock animal (i.e., deer or wild boar). They would rip through fur and hide as they started to eat primarily organs (Vester Boler, Swanson, Fahey, 2009). During the initial feed they would consume a high volume. This might be followed by a long period of rest, and then on the second day eat muscle meat and rib bones. The last night although satiated they may gnaw lazily on a remaining leg bone, or sharpen their carnassial teeth. This scenario prompted us to formulate a diet plan that offered a variety of food types including deer, pork and foul. In addition, we wanted the diet to include bones, hide, fur, and of course organs.

We started by calling the vendors we use in our restaurant and requesting their sources for exotic game meats. Many of those suppliers were able to offer us steaks and ground meats (i.e., bison, kangaroo), but were unable to provide us with hides, bones, or organs. Local butchers were slightly more helpful since they carried some of these items, but only from processed beef and pork. Eventually, we contacted Rocky Mountain Meats, a local game processors. They were excited to partner with us and we quickly set up an appointment to discuss what items they would be able to provide.

Once we established a supplier, and a list of food items we were going to acquire we contacted United States Department of Agriculture (USDA), the tiger Species Survival Plan (SSP) nutritionist, our veterinarian, and Denver Zoo's nutritionist to ask about any concerns or ideas they may have with regard to our diet plan. One nutritionist had a concern about wasting disease (disease that infects the brain and spinal cord of deer) because of the possibility of the disease being transferred to the consumer. Our veterinarian had no concerns having worked closely with a research study being done at Colorado State University regarding wasting disease and its effect on North American carnivores. Even though there were no concerns, we selected to not use the head of a processed deer.

Simultaneously we were working with Midwest Research Swine who had previously sourced pork for Carnivore Essentials to develop products that would work for our zoo carnivores. While they do not provide a ground product they have an extensive list of products with hides, bones, and muscle meat. The combination of four different meat and animal suppliers had completed the list that would provide us enough options to develop a diet plan (Table 1).

**Implementation**

The new diet plan was implemented October 2016. Table 2 shows the original diet plans for each tiger. The differences in each animal's diet plan were based on food availability and the severity of IBD symptoms.

In April of 2017 Jalan seemed to be showing the most positive response to his new diet. We transitioned all three cats to his diet plan and within just 3 months we had to change from offering feathered chickens and turkeys to "dressed" bone-in chicken and turkey because the tigers didn't like the feathers.

**Results**

Although clinical results of this diet transition are hard to quantify, there were many observations that indicate there were positive effects on the tigers as a result.

Prior to the diet change each tiger was still treated with prednisolone, omeprezole, and Metamucil. Flare-ups were treated with carafate, tylosin, clavamox, sulcralfate, and metronidazole. Since the diet change the daily medications and supplements have been greatly reduced and changed. The frequency of flare ups decreased from daily to bi-annually with the flare ups lasting for shorter periods. This reduction and frequency of IBS flare ups also resulted in each tiger only receiving the medication tylosin.

When looking at behavior, it appeared to the trainers that the tigers were feeling a lot better. We observed a decrease in behavioral symptoms like lethargy. During "flare-ups" we would often find the tiger curled up on the benches or in the reserves, unwilling to move quickly or participate in training sessions. Another behavioral symptom that we often observed was tigers walking with an arched back. After the diet change tigers were alert, much less lethargic and walked normally.

Before the diet change, on average Besar vomited every four days, Marah every eight days, and Jalan every six days. The contents of the regurgitated food was primarily undigested meat and on occasion undigested blood. After the diet change the vomit changed in consistency, and consisted of stomach acid, fur, bone, and occasional plant matter.

Vomiting also was observed to be less frequency for two of the tigers. Besar now vomits on average every four days, Marah every 15 days, and Jalan every 24 days.

During the implementation of the new diet, there were occasional food item change. Fast days and furred rabbits were removed in October of 2017 because trainers noticed the cats often vomited on fast days and days after rabbit was eaten. Furred rabbits were not palatable by the tigers so often they opted for fast days when fed those items, eventually furred rabbits were replaced with dressed rabbits.

One of the most easily quantifiable results of the diet changes are seen in the consistency of their feces. Feces are rated from a one to a seven, using the Purina Veterinary Diets fecal scoring chart (Image 5). For the years prior to the diet change the tigers would have undigested meat in their stool. Although there was not much of a change in fecal ratings, once the tigers were transitioned to the new diets undigested meat was no longer present in any stool. Fecal ratings prior and post diet change averaged a rating of 3 for all three tigers. (t-test results, Besar: p= 0.58, Marah: p=0.44, Jalan: p=0.83). Even though there's been no significant improvement when doing a statistical analysis, subjectively the trainers feel like the animals fecal quality is improving.

A major difference in the behavior of the tigers is their participation in training sessions. Each tiger typically participates in four training sessions per day. Table 3 shows how each session is rated on two different scales: their training motivation (one through five) and their food motivation (excellent, good, fair, poor, did not eat). In the years leading up to the diet change, each tiger was scored relative to how symptomatic they were at the time of the session, and not necessarily how they would train if they were not experiencing a flare-up. This is explained in the following manner; they would receive an excellent food motivation score and a five on their training motivation score (E5) just for coming to the session, even if they did a couple of easy behaviors halfheartedly, walked away and left food behind. In hindsight, trainers have learned to be less subjective when rating training motivation. Since the diet change, each tiger has improved their food and training motivation, receiving what trainers believe to be true "E5's". In addition they demonstrated quicker progress on learning new behaviors. Even with these subjective and relative ratings, training ratings have improved for all three tigers (Besar: p=0.003 r=0.12; Marah: p=1.53E-13 r=0.59; Jalan: p=1.01E-05 r=0.35).

Another aspect of training that has been impacted because of the diet change is how often the tigers participate in shifting. Typically, trainers rotate different tiger combinations on and off of exhibit three times per day, in addition to the standard shifting that occurs for cleaning their holding cages and exhibit. Prior to the diet change shifting was not as reliable and sometimes did not happen because a tiger would be unmotivated to move. On occasion, a tiger would shift, but not eat the food offered to him as reinforcement. It was suspected the cause of refusing food was an IBD flare-up. Since the diet change, food reinforcement is now almost never refused as well as the shifting behavior itself.

The least significant affect of the diet changes has been the program cost. When ordering from Nebraska and Carnivore Essentials, the average cost per month was $2025. Once switched over and buying from Nebraska, Rocky Mountain Meats, and Midwest Research Swine, the average monthly cost turns out to be $2225. This is a 9.87% increase in cost, but instead of only getting horse and pork, the tigers receive horse, pork, beef, rabbit, chicken, turkey, deer, elk, pronghorn, boar, and lamb. Carcasses, hides, skins, organs, and bones of the various animals are offered weekly as well.

**Conclusion**

There have been a number of benefits to implementing this diet change, including decreased medication usage, better consistency of feces, reduced vomiting, and increased positive behaviors. After several trial months of this diet plan, the evaluation by the staff was that it is improving the health and welfare of the tigers. Although, changing an animal's diet can be overwhelming, it is a slow process that requires significant planning. If you are going to implement a new diet plan, here are some basic steps to get you going in the right direction:

Step 1) Research – You should know the natural history and feeding habits of the animal in question. Take into consideration the individual animal's history and health issues. Your veterinarian should be involved in all aspects of the diet change.

Step 2) Develop a plan- What does the ideal diet plan look like? What schedule would be best suited for the animal? What is the caloric value of each product and associated nutritional value? Do these values meet the needs of your animals to sustain a healthy weight and activity level?

Step 3) Source- Reach out to local game processors, and local exotic meat suppliers You could even talk to your neighborhood butcher to see what they have available. Contact other facilities to see what products they use, and how they are acquired. Use all of your resources, inside and outside your facility.

Step 4) Implement- Transition the animal to the new diet at a pace that is recommended by your veterinarian.

Step 5) Evaluate- After a trial period, evaluate your animals behavior, motivation, and health. Are they more active? Less active? Have training sessions improved? Do you see a positive or negative changes in physical indicators (i.e., feces, frequency of regurgitation, blood values)?

Obviously, these five steps are many small steps that require a research and staff time. For the staff at the Downtown Aquarium Denver, this time and research paid off. We have seen increases in the welfare of our three tigers by decreasing the symptoms of their IBD. We believe that this type of naturalistic diet plan can be implemented with many species, carnivore or not, making every diet a little more “real”.

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| **Item desired** | **Supplier** |
|---|---|
| hides, bones, meat, and organs from elk, deer, antelope, lamb, pigs, cattle, and turkey | Rocky Mountain Meats |
| ground beef and horse, bones, and chunk muscle meat | Nebraska |
| pork hide, bone, and muscle meat | Midwest Research Swine |
| turkey and chicken | Rodent Pro |

*Table 1: List of suppliers and what they provide for Downtown Aquarium*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Marah | 2.6kg pork 1.5kg chunk meat , pork ribs | 2.6kg pork 1.5kg chunk meat, horse ribs | 2.6kg pork 1.5kg chunk meat , pork shank | 2.6kg pork 1.5kg chunk meat, pork skin | 2.6kg pork 1.5kg chunk meat | 2.6kg pork 1.5kg chunk meat, horse knuckle | Marah 2.6kg pork 1.5kg chunk meat |
| Jalan | 1 rabbit | 1 turkey | 3.5kg beef organ 3.5kg beef any hide | 1 kg beef organ 6.5kg beef, beef femur | beef knuckle 3kg beef | fast | 1 rabbit |
| Besar | 6.25kg deer and deer hide | 6kg deer and deer leg | 1kg deer | fast | 6.25kg deer and deer hide | 6kg deer and deer leg | 1kg deer and deer rib cage |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pull | 1.5kg chunk meat (mon), 2.6kg pork (wed), 4kg beef organ (wed), 6.5kg beef (wed) , horse ribs, deer leg (mon) | 1.5kg chunk meat (tues), pork shank (tues), beef hide( tues), 2.6kg pork (thur), 3kg beef (thur), 6.25kg deer (thur) | 1.5kg chunk meat (wed), pork skin (wed), beef femur (wed), 2.6kg pork (fri), 6kg deer (fri) | 1.5kg chunk meat (thur), beef knuckle (thur), deer hide (thur), 2.5kg pork (sat), 1 rabbit (sat), 1 chicken (sun), 1 kg deer (sat) | 1.5kg chunk meat (fri), horse knuckle (fri), deer leg (fri), 2.6kg pork (sun) | 1.5kg chunk meat (sat), deer carcass (sat), 2.6kg pork (mon), 3.5kg horse (mon), 6.25kg deer (mon) | 1.5kg chunk meat (sun), pork ribs (sun), 2.5kg pork (tues), 6.5kg horse (tues), 6kg deer (tues) |

*Table 2: Sample of one week of the feeding and pull schedule*

| **Training Rating Scale** | | | **Food Motivation Scale** | |
|---|---|---|---|---|
| 1 | Did not participate, did not calm station to start the session | | Excellent | Eats everything and cleans up mess |
| 2 | Started session but no interest in doing behaviors | | Good | Picky about which food they'll take but eating mostly everything, doesn't clean up crumbs |
| 3 | Missed over half of cues | | Fair | Eating if you hand feed only but not eating what you push under, spitting food |
| 4 | Missed a few cues | | Poor | Eating after you hold it to the mesh for a long time |
| 5 | Hit all cues | | Did not eat | Smells food but refuses or refused all together |

*Table 3: Training and Motivation Scales that trainers use to rate each session completed with a tiger*

*Image 1: pre-diet change fecal with undigested meat*

*Image 2: pre-diet change loose stool*

*Image 3: post diet change fecal, firm with digested bone*

*Image 4: Post diet change fecal formed with hair*

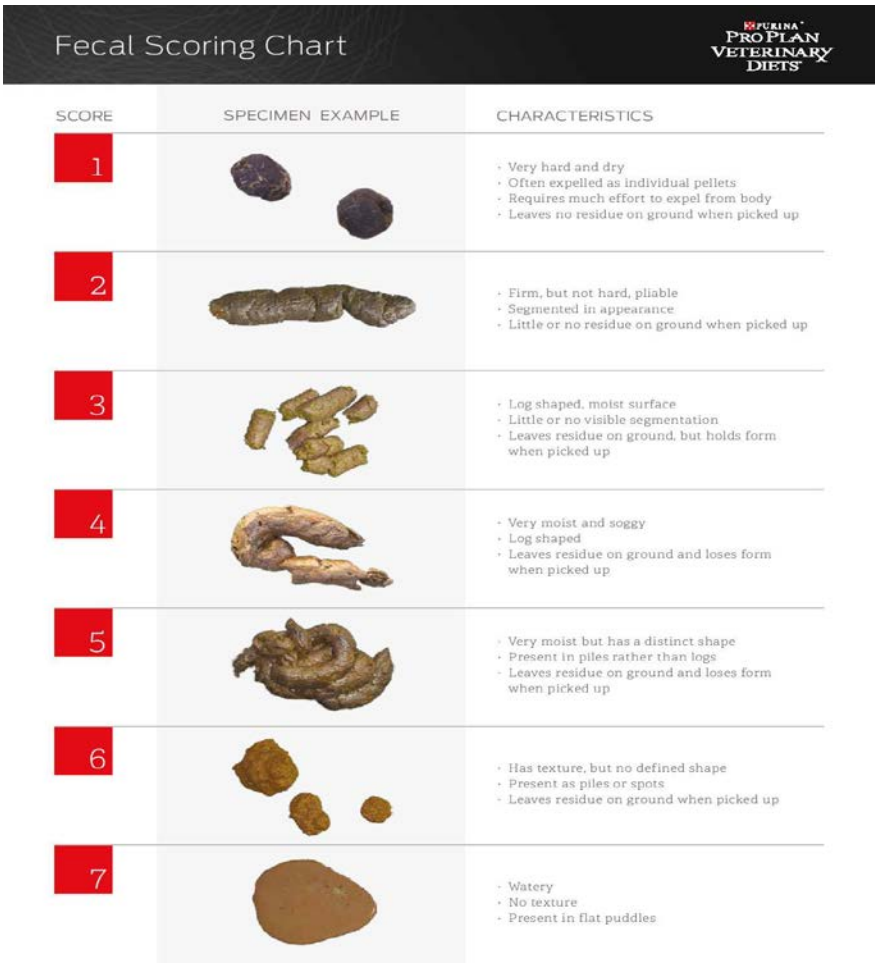


Image 5: Fecal scoring chart used for rating stool for the tigers
http://doi.org/10.3201/eid1803.110685

# Walking Her Way to a New Elephant: Developing a Weight Loss Plan for an African Elephant

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In 2017, the Elephant Encounter/Night Keeper team at Utah's Hogle Zoo modified the daily husbandry of Christie, a 31 year old female African elephant (*Loxodonta africana*), to promote weight loss, increase activity, and introduce additional cognitive behaviors. Utilizing both day and night shift animal care staff, a protected contact exercise plan was developed to walk Christie multiple times during the day, including once in evening hours. Staff focused on four main goals: session length, A to B's, strength and aerobic exercises with goals that were measured and discussed each month. Lastly, a cognitive innovate behavior was trained, which involved Christie choosing which behavior to offer and allowed for innovation. Introducing cognitive behaviors into her repertoire gave Christie choice and variation during training sessions offered an average of three times per day.

With this plan, the team was able to incorporate more variation in the day and a decrease in her stereotypic behavior was observed. With the innovate behavior, Christie offered a variety of established behaviors as well as many new behaviors throughout the sessions. Keepers also saw an increase in activity within her environment, as well as play with both keeper staff and her 8 year old offspring. It is the plan to continue this training strategy, and introduce more cognitive behaviors that will promote complex challenge, choice, and control as well as both mental and physical health.

Christie lives at Utah's Hogle Zoo with her nine year old female offspring, Zuri. The area also houses 1.1 Southern White Rhinoceros. Elephant Encounter is 2.57 acres, comprised of four yards: one off-exhibit yard, a "kopji yard", work yard, and pool yard. There is also a barn with four large stalls that is used in colder temperatures. The yards are all connected through shift doors, making it possible to give access to one to four yards at any given time. Usually, the rhinos are in the "kopji yard", while the elephants are in the work yard and the pool yard. This combination changes seasonally. For example, if it is too cold for the rhinos to be outside the elephants can be given access to all four yards and the barn. Additionally, keepers will switch yards for a short time for variety. The pool yard is the largest yard, and includes a large pool that is 18 feet deep, with a stream running through the exhibit emptying into the pool. (Picture 1) There is also a large mud wallow, which keepers fill regularly. The work yard has a heated cement pad, and three "working walls" that have access panels that are either open with bars, or have mesh with doors that can be opened from the outside. It also has an umbrella shade structure, with a hoist that is used for feeding and enrichment. (Picture 2) Most of the substrate is sandy dirt in both yards, and is tilled regularly. The work yard and pool yard are connected through a chute, which is out of public view. The elephants are trained an average of three times throughout the day, these sessions include husbandry, exercise, and play behaviors. Keepers also offer baths and other interactive sessions regularly. Enrichment is given daily, and is on a rotating schedule, using five categories (manipulative, environmental, sensory, behavioral, and foods/feeding) to work towards specific goals for each animal or species.

Feeding is spread out throughout the day, averaging around 10 feedings per day and variable ways how food is presented.

From Memorial Day to Labor Day, there are twice daily public training demonstrations at 10:30a.m. and 1:30p.m. This schedule of demonstrations can make the day predictable. The elephants are shifted into the work yard and trained while a staff member narrates. Christie and Zuri are conditioned to anticipate these sessions, especially with the drum circle guests participate in before each demonstration. This has resulted in an anticipatory behavior of swaying at an out of view shift door prior to the demonstration. After each demo, the elephants are shifted to the pool yard to eat fresh hay and scattered greens that keepers put out before the demo. During this time the work yard is cleaned and fresh hay put out, Zuri is then shifted into it so she can get her full portion of hay without Christie eating most of it. Christie then comes into the chute between the two yards and sways in anticipation of her next meal.

Managing Christie's weight had been an ongoing goal but we were not seeing the results we hoped for by simply managing her diet. Christie weighed in at 8,600 pounds in April of 2017, with the goal weight being between 8,000 and 8,200 pounds. The team decided to incorporate more training sessions into Christie's day during the time between and after training demos. This was achieved by walking Christie in the pool yard while Zuri was shifted into the work yard. Using a hay-enhancer pellet that is part of her regular diet, or allotted training produce, keepers walked along the outside of the fence with Christie and stopped at different intervals to have her do strength and aerobic exercises, such as leg lifts, stretches, crouches, and turns. (Picture 3) Keepers also had Christie step over large logs that are scattered throughout the pool yard, and had Christie cross the stream that runs through the yard to an underutilized portion of the exhibit to extend the distance walked.

The elephant team is also home to the Zoo's night keepers. The night keepers work closely with all areas of the zoo, but particularly with the elephant team. Night keepers are utilized to extend feeding and training. Christie was then able to be walked once in the evening, after the Zoo is closed. Night keepers trained an A to B behavior with Christie to add something new to her walking routine. Once Christie learned the "Go To" sD, keepers started moving to new spots so Christie always had to walk to a different spot to find the other keeper each time it was asked.

An innovate behavior was also trained with Christie. This is a cognitive behavior that allows the animal to choose which behavior to give, including established behaviors, but also things made up on the spot. The sD is "Show Me Something" and Christie has to give a different behavior each time it is asked. If she has already given a behavior, keepers give the modifier "Something Else" and she has to show some other behavior. This was trained to give Christie more choice and control during training sessions. The keepers were unsure how well Christie would learn this behavior, since this was the first cognitive behavior of this kind to be trained for either elephant. Even though it is a somewhat complex behavior, Christie learned it quickly. In about five sessions she started understanding that she could give any behavior, but then she would just offer the same behavior every time because that is what she was reinforced for doing. To get around this, any movement was bridged and reinforced, or the keeper would wait for another behavior to be given. Soon she was offering different established behaviors each time it was asked. She has offered one unestablished behavior consistently, crossing her right foot over her left leg, but it is hoped that she will start to offer more "new" behaviors.

By the end of the summer Christie weighed in at 8,100 pounds with being walked 2-3 times a day. However this plan resulted in much more than weight loss. Keepers observed an increase

in play and exploration of her habitat. Christie got in the pool on her own accord for the first time since the exhibit was built in 2005. She was seen playing more with Zuri, and interacting more with the keepers without food present. Christie sometimes shows a lack of energy and motivation during the hot Utah summer; however during the walks she showed a whole new side, one that shows she has higher motivation than originally thought and is excited to learn more complex behaviors. She would pick up rocks and sticks and carry them from spot to spot while walking; handing them to the keeper once she got there. She was seen walking briskly from keeper to keeper during A to B's which was out of character for Christie.

Not only was this exercise plan beneficial to Christie, but to guests as well. Instead of Christie waiting in the chute where she cannot be seen, guests can watch Christie being walked, learn about our exercise program and how we keep our animals healthy, and encourage positive elephant welfare. This experience was also beneficial to the keepers. Getting creative with how animals are managed can demonstrate how resourceful and innovative those animals are and shows that assumptions made about some animals may not be accurate. In the future, it would be beneficial to do ethograms, to gather data on the elephant's behavior in regards to their environment, and provide more measurable information on Christie's stereotypy.

Walking Christie is now an integral part of every day during spring, summer, and fall. The team plans to continue adding in new opportunities for exercise throughout the year, especially when it is too cold for them to explore their entire exhibit on the few days they can't. Adding more variety during training sessions is in progress as well. For example, changing the location where the elephants are trained during demos. More cognitive behaviors are in training, including teaching them pattern matching with different patterns and colors. Continuing this plan not only benefits Christie in the present, but will help her age gracefully.

I'd like to thank the Elephant Encounter team for all their hard work, support, creativity, and receptiveness to working on this successful behavioral management strategy together. I would also like to thank our curator, Erin Jones, for all her support and encouragement.

Photo 1: Pool Yard

Photo 2: Work Yard

Photo 3

# IMPROVING THE VOLUNTARY PARTICIPATION OF A HARBOR SEAL (PHOCA VITULINA) DURING CATARACT SURGERY PREPARATION AND RECOVERY

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**Abstract**

In August 2015, the Rocky Shores staff at Utah's Hogle Zoo began observing vision difficulties with Nika, a 12-year-old female harbor seal (*Phoca vitulina*). Bilateral cataract surgery was recommended and scheduled with veterinary specialists. In the weeks prior to surgery, training intensified to accommodate recommended pre-operative medical treatments. During this time, Nika's motivation for training waned, and the necessary behaviors deteriorated. The decision was made to postpone her surgical date by six months. The lengthened timeframe enabled staff to develop a plan for increased motivation and flexibility. Staff decided to focus on four main goals: session length, shifting, tolerance for training on land, and reliability of applicable medical behaviors. Each of these goals was placed on a variable written schedule and randomized throughout each month, ensuring that there was structured progress toward goals.

Following a successful surgery, Nika was cooperative during her entire recovery: she voluntarily participated in all training sessions including the administration of 21 sets of eye medications, and the care and removal of her intravenous catheter. During this time, she engaged in husbandry training and was introduced to novel behaviors such as "The Training Game" (Pryor, 1999) to encourage interest in training.

It is the belief of the Hogle Zoo staff that this variable and multifaceted approach created a successful outcome throughout the surgical process. It is our hope that these extensive preparations can inspire other facilities as they prepare for procedures with their animals and enable them to enjoy success stories like Nika's.

**Introduction**

The pinnipeds residing at Utah's Hogle Zoo consists of 1.2 harbor seals and 2.0 California sea lions. The animals are housed in an artificial salt water pool that is 175,000 gallons and averages 12ft in depth. There is a large, central island that the animals can swim under, as well as rocks for basking, a waterfall, and dock space for hauling out. Shade is provided by small permanent shelters year-round; in the summer shade cloths are spread across about two-thirds of the pool. The holdings consist of a 9ft deep freshwater pool connected to a large dry holding space that can be separated by a gate, as well as a second dry holding which is the location of our scale. All the holdings lead directly to the exhibit. Animals are on exhibit most the of the time with access to holdings in inclement weather.

The harbor seals are trained three times a day; the first session can be between 8:30-9:30AM, and the other two sessions are scheduled for 11:30AM and 3:00PM. During these sessions, our staff works on a variety of behaviors with the animals, from medical behaviors such as blood

draws and exams to exercise behaviors such as porpoises and mimics. It was during these sessions in summer 2015 that Rocky Shores staff started to notice that one of our female harbor seals, Nika, seemed to be having vision issues. The biggest issue that we heard from the trainers was that Nika was ignoring them. She would sit in front of the trainers and offer behaviors; sometimes she was correct and sometimes she was not even close to the requested behavior. The Primary Relief Keeper and Primary Keeper worked with Nika as much as possible to see if they could pinpoint the breakdown in the behavior. Finally, in August 2015, it was determined that Nika could not see the cues being issued.

As with all resident animals, the three harbor seals that live in Rocky Shores have very different personalities. Nika, is generally laid back, but will also try to get away with lower criteria in behaviors when she is not particularly motivated for a training session. Molt for the harbor seals at Hogle Zoo is generally late June to August, so a change in motivation at this time is not uncommon and follows the baseline for these animals, so when Nika was being reported as being less energetic and engaged, and missing $S^d$s, it fit what could have been a natural motivational shift for her. After her molt, these behavior changes did not resolve as they normally would, and the Pinniped Team began to look for other answers to Nika's motivational shift.

The diagnosis of cataracts for Nika initially started with some very low-tech testing. Trainers gave $S^d$s then started moving hands farther and farther to the sides to test peripheral vision. There were "sweet spots" where she could see better than others; this was coupled this with strong remote, distance training to increase the success of her sessions. Cotton balls dropped by her eyes tested if she saw the small motion. Photos are taken monthly for records and this effort doubled, especially when it came to Nika's eyes so that there would be a record of what was happening. Veterinary staff was also there every step of the way, taking their own records, trying to find the best ways to photograph and see what was happening to Nika's eyes.

By September 2015 Nika was diagnosed with bilateral cataracts; the cataracts were originally diagnosed in the right eye, but the left eye was diagnosed soon after. At 13 years old, Nika was young and the decision was made to schedule surgery in April 2016 with Dr. Carmen Colitz. This would give the Rocky Shores team seven months to work on the training necessary for the surgery and recovery.

**Surgery Preparations**

The Rocky Shores team and the vet staff quickly started to work on a plan for Nika. Pre-surgery called for multiple eye drop sessions a day, sometimes with multiple drops a session, with up to 15 minutes on land at a time. Nika needed to be comfortable with coming into holdings regularly and being drydocked when inside. These goals all seemed achievable since there were seven months to work on them. Challenges included: Nika's eyedrop behavior was not complete, average session length was around eight minutes, all animals had an aversion to being drydocked, and Nika was inconsistent at shifting.

Trainers set about working on increasing durations for drydocking and land time slowly. The entire Rocky Shores staff worked on the eyedrop behavior and it was established in a short period of time. Nika was shifted in regularly. Approximately one month from the surgery, with session goals becoming progressively harder. The surgery was scheduled for April 7, 2016; as the date drew closer, the more Nika's motivation waned until she stopped participating completely in sessions. As a result, the surgery was canceled and rescheduled for December 1, 2016.

What happened? There was more than enough time to get ready. Trainers were taking established behaviors and were working on them to get ready for the surgery. Where did trainers lose her motivation? These were the important questions the Rocky Shores team needed to reevaluate in the preparation plan. Nika would need to participate fully to make this procedure successful.

There were three goals for reestablishing Nika's participation: reestablish motivation, reestablish shifting, and strengthen eye drop behavior. With these new goals, a new plan was created to keep Nika interested in the goals. The team was determined to succeed this time.

To reestablish motivation, trainers temporarily stopped asking Nika to shift inside so frequently. Previously she was required to come in at least once a week to weigh, but it was decided to give her a break from the constant shifting since it had been paired with negative dry docking. Training with Nika was focused on Rocky Shores core staff rather than the addition of all relief staff. This allowed a core team to work on communication with her, solidify relationships, and keep the communication between the trainers as clear and consistent as possible. A calendar of variable times for session lengths and amounts of time that Nika needed to be on land for each session. This planned variability kept trainers more variable than doing it without prior planning.

Shifting was its own goal. This also made an appearance on the Nika calendar. Rather than have her shift regularly, she was on a variable schedule for 1-4 times a week to come in the building. This shifting was also built into the time that she needed to be on land and the length of session time so that her sessions were more fluid.

Her third goal was to strengthen her voluntary eye drop behavior. Veterinarians were still working on the post-surgical medications, but it sounded like it was going to be a number of drops. While the behavior was complete, trainers wanted to tighten criteria. Nika was not to receive "eye drops" (saline practice drops) at every session. The behavior could still be worked every session, including no-goes of holding still, movement around the head, and saline drops with a release straight to the pool. Increasing the variability around the behavior decreased some of the associated negativity and allowed trainers to increase the reinforcement for the behavior.

The results from working on all these goals? Immediate improvement in shifting, eye drop behavior, and motivation was observed! Now that Nika was participating, trainers still needed

to keep working on surgery preparation. The goal-based sessions kept moving forward with the help of calendars to keep everything as random as possible – session length, when Nika came inside, and how long Nika needed to stay on land. There were even sessions when Nika had no goals at all.

**Results**

With the new goal-based plan, Nika's motivation remained very high leading up to the new surgical date and all the goals were being met. The week before the surgery, Nika was shifted inside on the first try and kept in the holdings until the surgery. While inside, she had access to the holding pool and the large dry holding area. In the week prior to the surgery, the pre-surgical eyedrop regimen required 5-7 training sessions a day, with each drop requiring five minutes of time on land following each drop.

Due to the goal training with Nika in preparation for the surgery, this pre-surgery time went smoothly. Nika consistently had high motivation, no issue with staying on land, and anticipated the sessions. Nika seemed to enjoy the "inside time"; lots of one on one attention with staff, enrichment that was selected specifically for her, and no other animals in session at the same time continued to strengthen the bonds that trainers had with her.

In preparation for the actual surgery, Nika was dry docked the night before; when locked out of the pool she was calm and displayed no negative reactions. The morning of the surgery she trained for her eyedrops and voluntary injection without primary reinforcement and required minimal negative reinforcement for crating. She was calm in her crate as she was moved to the surgical suite across the parking lot at our hospital. Without the increase in relationships with Nika in the months leading up to the surgery, none of this would have been possible. The crating behavior alone had been stressful in the past, even with primary reinforcement present. As of this paper, Nika is back to voluntarily crating.

After a successful surgery and recovery, she was moved to the small holding in the pinniped building. In collaboration with the vet staff, it was determined that Nika would recover better in a familiar environment than in the holdings in the Animal Health Center. Holdings were padded as recommended to prevent Nika from rubbing her eyes. The morning following surgery Nika was offered some food. The vet staff had cautioned pinniped staff that she may not eat for a few days; Nika typically will not eat when stressed and was allowed to gain a few extra pounds in anticipation of this fasting. Surprising everyone, Nika ate readily and trained extremely well – patiently taking eyedrops and allowing her catheter to be regularly cleaned and flushed.

Nika's recovery meant that she would have up to 27 sessions for the first 14 post-operative days, with the amount of sessions decreasing as her medications changed. She also had sessions where her catheter was cleaned and where she was cleaned. Nika salivates excessively when eating and could not get wet for the first 30 days after surgery, so she was given baths. Her holdings also had to be cleaned and complete eye and body exams were given to make sure that she was not getting sores. Her reinforcement for each session was between 1-5 fish.

Throughout the recovery process, the focus remained on novelty and variety in addition to the medications. The team focused on training behaviors that could be performed on land, including training Nika how to play the training game. One of the concepts that our team was interested in exploring with Nika was making her think a little bit more by working on more cognitive behaviors rather than just body manipulation behaviors.

Two of our staff members had previously worked with pinnipeds that knew how to play the training game and there are two traits that make an animal a good candidate for learning how to play: they do not show frustration with being incorrect and they are variable and will offer novel behaviors. Nika also has an innovate behavior where she can display a behavior of her choice, so staff hoped she would understand some of the concepts of the training game quickly. An $S^d$ was chosen at the beginning of the training process to give Nika more information about the game; it allowed trainers to tell Nika that the game was still in process and that she should keep working out the goal. The game ended when completed the goal or when she was asked for another behavior by the trainer. This varied from the training game that was outlined by Karen Pryor in Don't Shoot the Dog (Bantam, 1999). Our team needed another way to end the training game as some of our sessions consisted very little primary reinforcement due to the large number of sessions Nika had daily during recovery.

**Discussions**

Even though staff had similar time frames for preparation for both surgeries, the approach was vastly different. It is important to have clear communication with all staff on the same plan, variability, and clearly defined goals.

Nika's surgery required a large time investment from the Rocky Shores staff in both the pre – to post – operative stages. The benefits from this investment – consistent participation in training, success in medication administration, less stress for the animal and trainer, and a smoother recovery – is still being redeemed today. At one and a half years post-operative, training relationships with Nika are still as strong as it was when she had her surgery. She remains consistent in sessions, eager to train, and shifts well.

Immediately following surgery, Nika tore the padding down from the recovery stall so she could see what was going on in the building because she had recovered her eyesight! She is thriving and if given the chance, will come into the holdings for some of the quiet, dedicated one on one time that she had during surgery preparation. When training outside she is more typical Nika, but during inside sessions she seems more engaged and ready for whatever the session holds.

The Rocky Shores team have replicated some of the same steps with the other harbor seals – notably the one on one time so that they can get that extra attention without the distractions of the exhibit. The other female appears to like the attention while the male does not like to be the only animal inside. Trainers have continued to have the random schedule of session times to keep session length variable. This helps with the animals anticipating how long the sessions

will be and prevents them from getting bored and breaking from session. These tactics have worked well and has kept sessions variable for the animals, trainers, and guests. Relationships were also strengthened with the harbor seals which has also improved the success of training behaviors being worked with the seals ranging from voluntary blood draws to waterwork. The trust that we have with our animals has transferred to our team working in the pool with them; in the last year, our entire team has started working on trust building and husbandry behaviors while swimming with the animals. This new perspective allows the team to see the animals in a new way and strengthens our relationships; with this new view our team can improve veterinary care as well as challenge ourselves with new training goals.

**Acknowledgments**

The authors would like to acknowledge the Rocky Shores team, Veterinary Staff, Jeff Landry and the curatorial staff at Utah's Hogle Zoo, Dr. Carmen Colitz, Dr. James Bailey, and all the facilities who offered their advice in preparation for the surgery.

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# Developing a Zoo Wide Team to Simultaneously Train 6.10 Hamadryas Baboons (*Papio hamadryas*)

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## Introduction

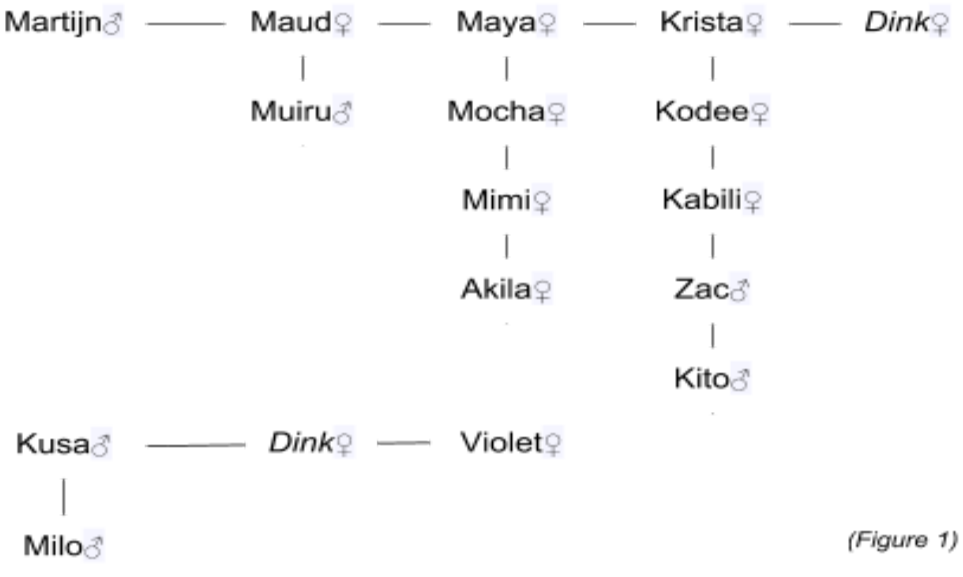
In recent decades, the care and management of animals have undergone immense changes for the better. We have realized the importance of training in managing animals medically as well as for mental stimulation. Trainers have come up with creative ways to overcome obstacles with their animals such as bringing in a second trainer. But what about bringing in numerous people to help train a very large group of animals simultaneously as one team?

At Oakland Zoo, we have a single One Male Unit (OMU) consisting of sixteen (6.10) Hamadryas baboons (*Papio hamadryas)*. Hamadryas baboons have a very complex, multi-level social system. This complex system can make separating, isolating, or accessing individuals extremely difficult. There are subordinates who are fearful of separating from the harem male, overbearing mothers, new mothers, geriatrics avoiding attention, maturing males with overwhelming emotions as they navigate their place, and many more combined scenarios. One keeper versus sixteen baboons are not favorable odds.

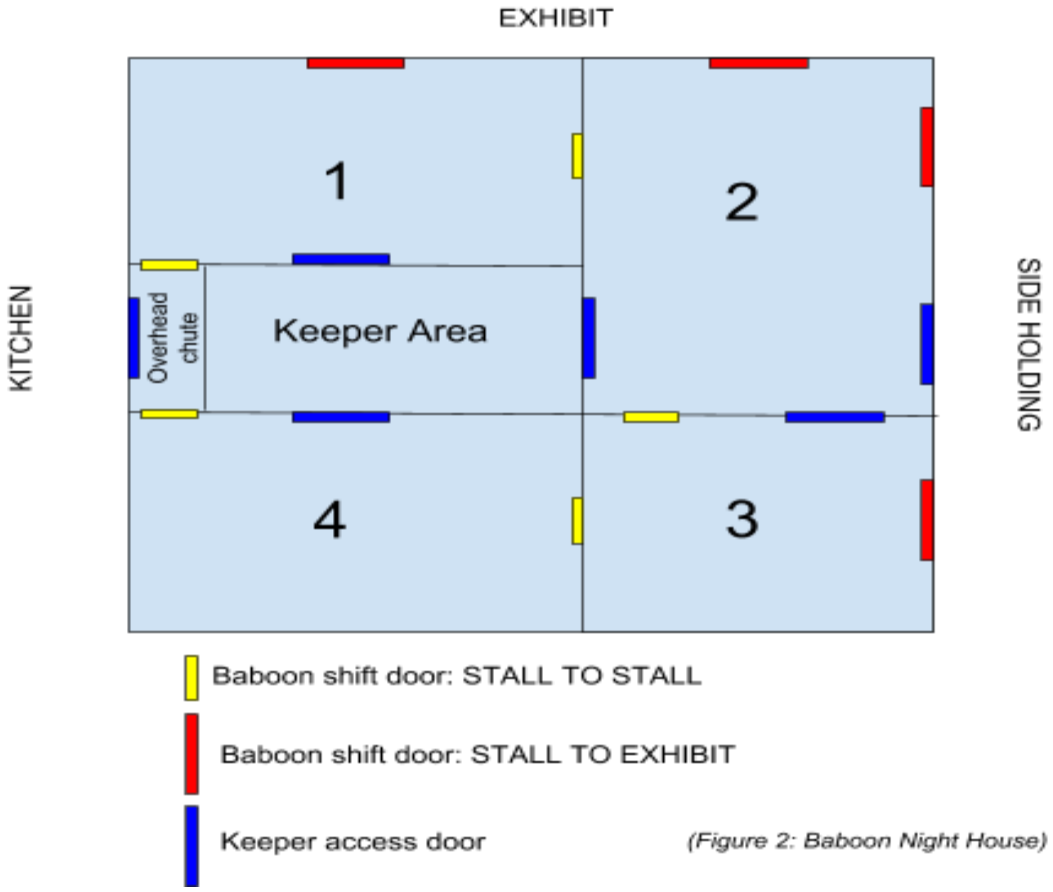
We knew we needed more people to help 'hold' baboons while others could be accessed and trained. In response, a baboon training team was developed to comfortably train every baboon within a shared space simultaneously. The team began with five trainers and has grown to almost twenty total trainers from all over the zoo (non-keeper staff, volunteers, apprentices, and keepers from all sections of the zoo). It was a rough start with countless changes along the way, but our team has come together over time and developed to what it is today, a success!

## Harem and Facilities Overview

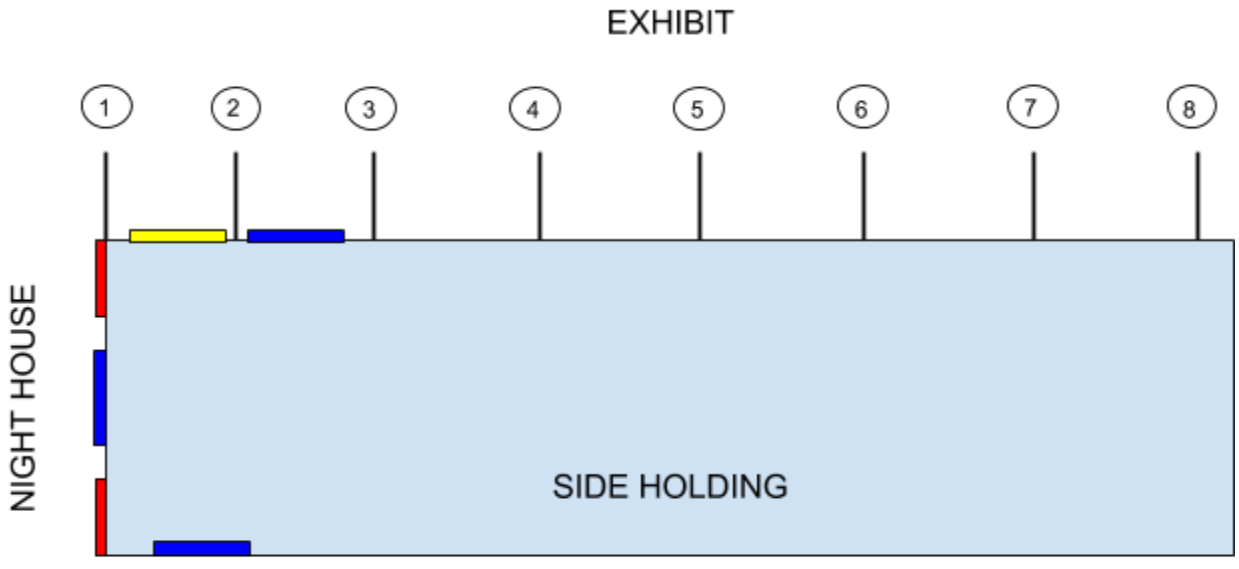
At Oakland Zoo, we house sixteen (6.10) Hamadryas baboons (*Papio hamadryas)*. In 2012, we received (1.3) adult baboons from a facility where they had no prior training (Martijn, Maud, Maya, and Krista). Since 2013, we have had eight births(Mocha, Kodee, Mimi, Kabili, Muiru, Akila, Zac, and Kito) and two additions from another facility, brothers Kusa and Milo. Dink and Violet are geriatric sisters and remain from the previous OMU (See Figure 1).




*(Figure 1)*




*(Figure 2: Baboon Night House)*




*(Figure 3: Side Holding and Training Area)*

## History

Prior to Martijn's group arriving in 2012, Oakland Zoo housed a small geriatric group of no more than five baboons at a time. Training was done opportunistically, but all five baboons were able to be trained in a group setting. Time and help were restricting factors when it came to training the baboons regularly.

When Martijn's group arrived, management and hospital staff began a regimented training routine while they were in quarantine. Once introduced to the other troop members on exhibit, keepers continued to face the same restrictions of time and help; they now had to manage multiple family groups. Consequently, their training regime quickly diminished as resources were very limited and keepers could not keep up. The group continued to grow rapidly making it increasingly difficult to play catch up. Cooperative feeding was maintained in the group, but no individual training beyond the dominant males were done. Immobilizations were done by catching a baboon by itself in an overhead chute before using a pole syringe to inject the animal. We needed change, our troop would continue to grow and we needed a way to manage individuals. We also needed to develop consistency with our cues, responses and training methods.

Our first thought in doing this would be to separate the group in the nighthouse into smaller groups. This was easier to do with the kids, but the adults proved challenging. Most were too scared to be separated from Martijn and feared retaliation. Oftentimes, when we got them to the point of separating, they would have a difficult time focusing because they were being threatened from the other stalls. While we wanted to continue to train separating from the group, we needed a different environment where they could be more relaxed. This would enable us to begin training behaviors to the individuals who were generally more difficult to access. Schapiro et al. describes, "the challenges inherent in attempting to train intelligent, socially oriented animals, like primates, without separating them from their social groups. Separating animals from their groups can be a time consuming process; more important, it can be stressful for both those removed and those remaining behind. Therefore, [they] prefer to work with intact social groups, even when the objective is to gain access, and train, a single animal for a particular behavior"(2003).

## Getting Started

To get started, we needed time, space, a way for the baboons to be comfortable, and trainers.

First obstacle: Time. We have one keeper to prep diets, enrichment, exhibits, and train Chimpanzees, gibbons, squirrel monkeys, wreathed hornbills, and baboons by the time the zoo opens. So we knew we needed to set up dedicated times throughout the week and later in the day so more people would be available to help. We started off with keepers who worked directly with the baboons and could easily identify them.

Second obstacle: Space. The night house was too cramped, even with them separated into smaller groups. However, we did have a long stretch of fencing between our side holding and the exhibit that seemed ideal. We could train them while they were still on exhibit, no shifting or separating was involved, and the public could watch.

Third obstacle: Baboon comfort level. In an effort to make the baboons more comfortable, we decided to put up visual 'blinds' down the fence line. Although the baboons could easily look over or walk around these, most seemed at ease and did not feel the need to constantly check everyone's location. Ultimately, the baboons were more focused during training sessions and not as easily distracted by others. Some blinds were just a board that could fit two baboons, while others had a board on top that made them resemble the letter 'T'. These allowed us to have up to three baboons at each station per one trainer in the beginning.

We started with five blinds or 'stations' along the training fence line and five trainers, one per station. Each keeper would each go to a station and feed whoever came over, even if individuals left or came over midway through. Initially, baboons were running back and forth to see what everyone was doing at each station, what kind of food there was, etc. It took a few sessions for our subordinates to feel comfortable coming up to fence line at all and taking food from trainers. At every session, we recorded which baboon was at each station. After seven sessions, the baboons began selecting consistent stations with a few exceptions. It took sixteen training sessions for the all of the baboons to stay at their stations, so we then began discriminately reinforcing them for going to that chosen station. The baboons picked up on this very quickly. Their choices were interesting because we thought we knew exactly how the baboons would line up and who they would sit next to according to dominance, but we were completely wrong. Their dominance hierarchy did not correlate to their individual comfort level.

Social dynamics change often within the group. Therefore, trainers keep note of how individuals are doing socially within the group and if they regularly leave their station in favor of another. If it appears they are no longer comfortable at one station, we will officially move them to wherever it is they are more comfortable.

Last obstacle: Trainers. We realized fairly quickly we needed more stations and therefore, more trainers. Some stations had one baboon while others had up to six (two adults and four juveniles). We began inviting more people from outside the string to help us out. We asked if they could participate and 'hold' baboons for us at a station so we could train other baboons. This is where I believe we started encountering challenges.

## Logistical Challenges

LARGE TEAM

More trainers meant more help, but it also meant more people to manage and coordinate. Some trainers were unfamiliar with primates and others had no training experience at all. Trainers not used to baboons or high energy animals were also having a difficult time focusing on more than one baboon at a time.

Having a group with such diverse experience, required new people on the baboon team to go through 'training'. This included spending time and getting to know baboons in order to habituate them to their presence. They needed to learn our primate cues and the criteria for the responses, then sit with a primary keeper to observe, and then be observed before they are signed off to train by themselves. Trainers should be expected to learn about the natural history and individual history of the animals for whom they train. When training, keepers need to understand how this affects that animal during the training process (Colahan and Breder 2003). Understandably, it was very difficult for trainers to learn all sixteen baboon histories and identifications as well as their relative social status' when only seeing them once or twice a week. This caused a lot of unnecessary attacks due to improper feeding techniques and lack of understanding our socially complex baboons. Lastly, the baboons who were being 'held' and not trained, were getting very bored.

We addressed these issues by doing a big change to our program. In addition to our primary trainers, we assigned secondary trainers as opposed to 'floaters'. Floaters were trainers from outside the string. They would fill in at different stations as needed, never having the opportunity to get to know the individual baboons. Now, the primary trainers would continue to work on new behaviors with their assigned baboon(s) and the secondary trainers were then able to assist in maintaining established behaviors and were available to work with the their designated baboon(s) in the primary trainer's absence. This enabled the secondary trainers to really focus on one to two select baboons, learn their history, personality, behaviors, and also their social status within the group and how it related to the baboons around them.

Daily records are kept and bi-monthly meetings are held with zoological managers to facilitate communication and track the progress of trainers and baboons. Since everyone is actively training, we do not have a designated person overseeing the trainers' progress. In order to make sure everyone is on track and not digressing from the correct cues and responses, our best solution is to video record the trainers during sessions. Another keeper with a similar training team for zebras relayed how they utilize a private YouTube channel where they can review footage and track progress. We have incorporated this by having our trainers record themselves during sessions and then upload them to the private channel. The trainers are also encouraged to use this resource to watch themselves and others to help develop their own skills. We have just started this project, but it does show a lot of potential.

COMMUNICATION

Having such a large group meant we had to improve our communication. Managing this group of almost twenty people was very difficult. So by having secondary trainers reporting to the primaries, and primaries reporting to the baboon keepers, we really streamlined our program communication methods. In addition, we extended training sessions from fifteen to thirty minutes to allow more discussion and stay updated on progress. With so many trainers, we devised a system in which each trainer stated very briefly a challenge or problem as well as progress or something positive that happened during their session, aka, "Good thing, bad thing". We really wanted the whole team to hear these accounts to prompt discussion, sharing of methods and ideas, and ultimately allow everyone to contribute positively to the overall training program. If the baboon keepers felt it necessary to discuss further with a trainer, we would ask them to stay and talk after so the other trainers were free to leave or could hang out and join the discussion.

COMMITMENT

Lastly, we are zookeepers. We deal with the unexpected on a daily basis. Things come up and keepers are not always able to make it to training. One trainer not being able to make it can cause us to cancel the entire session. We do try to appeal to the trainers coming from outside the string by keeping training sessions quick, efficient, and well worth their time. We are very fortunate that these trainers really enjoy working with the baboons and do not feel inconvenienced.

There are factors out of our hands that put strain on the training team. Staff expansion and changes cause people to involuntarily withdraw from the team. This results in a lot of our time and energy to find, recruit, and train a new replacement and can be daunting. Foul weather is also a cause of frequent session cancellations, especially during winter. The training fence line is not sheltered, so most baboons are indoors and do not want to participate.

## Animal Challenges

Changes happening within the baboon group affect the success of each session. When females go into estrus, the males either stop participating to go sit with the females, or run back and forth multiple times between stations to check on her. Oftentimes, this causes the female to be too intimidated to take food from their trainer while the males are paying them such close attention. Still, we try to push through the session, but concentrate more on recall, focus, and cooperative feeding instead of working on new behaviors.

We do have an active breeding group. Therefore, when a female is pregnant or has a new baby it shifts the social structure. We also see a lot of shifts with maturing juveniles. Young females are learning their place in society and young males are becoming more inclined to play at fighting (Kummer 1995). At one point, we had so many issues with our unrelated males Kusa and Milo, that we had to take a step back from group training. They were becoming increasingly disruptive, constantly attacking our geriatric females (Dink and Violet) and Kusa (the more dominant of the two), would attack Milo seemingly without cause. We tried several alternatives to group training that involved a lot of shifting and were not always successful. Nothing seemed to be working, so we canceled our group training

while we worked more with Kusa and Milo in our daily routine. We did more cooperative feeding with both boys and the older girls and less separating and reintroducing. When seperating was necessary, we incorporated more training into the process to ensure it went as smooth as possible. After a time, we decided to try again since the boys had learned to interact better during training sessions. The boys were very cooperative and focused. Kusa, Milo, Dink and Violet's trainers continue to stay very in-tune and communicate with each other while training to ensure their continued success.

## Discussion

Overall, our baboon training team has been a great success and we continue to hold group training sessions twice a week. On average, we have about thirteen trainers at each session for all eight stations, which is ideal. We have been able to train multiple baboons to allow for cooperative injections as well as to separate and enter a crate in their night house for successful immobilizations. With our most difficult to separate low ranking female, we have been able to administer routine contraceptive injections during team training while we continue to work on increasing her comfort when separating from the harem indoors. We have been able to feed and work with our geriatric females who were previously terrified to take food anywhere near the rest of the group. All the baboons, including our less than one year old infant, are at least trained on very basic behaviors. With one to three assigned baboons, keepers are now able to regularly fit training into their daily husbandry routine (when shifting in for breakfast, lunch, or dinner). Enriching such a large group of baboons everyday is also challenging, so it is gratifying to be able to add training into their daily routine.

We do have future plans to utilize our training team to train each baboon to accept oral medications via syringe. We have difficulty reliably administering foul-tasting deworming medications to many of our baboons.Some of them drop the meds and others pick them up increasing the risk of overdosing. We have experimented with a multitude of delivery methods with little success. If we are successful with syringe training, we will be able to ensure the exact amount received by each baboon and eliminate the chances of overdosing. We also plan on making facility modifications to better access the baboons for behaviors such as ultrasounds and blood draws.

The baboon training team is still ongoing and continues to develop. As the program progresses, the success of the team will only mean confronting more difficult challenges. It is of no doubt to me and my team that we will be ready to tackle the obstacles ahead of us.

**Acknowledgements**

I want to thank our entire baboon training team and everyone that was a part of getting it started. Our management for participating and/or allowing so many other keepers the time to participate in an area that is not their own. Thank you to the string team: Dannielle Stith, Kelly McDonald, Michelle Heywood, and Melissa Lory. You all take so much time out of your days and really commit yourselves to the baboons. You all continued to support me through thick and thin, and I admit, there were some very trying times. Special thank you to my supervisor Dannielle Stith for helping lead the baboon training team and your continual efforts to advance the baboon program. You are always supplying me with numerous resources and are always a wealth of new ideas.

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# Assessing and Managing Changing Troop Dynamics of a Bachelor Troop of Francois Langurs *(Trachypithecus francoisi)*

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*Author's note: originally presented at the 2017 Old World Monkey TAG Husbandry Workshop. Paper includes updated information based on events occurring after initial presentation.*

Kansas City Zoo houses a troop of 4.0 Francois langurs *(Trachypithecus francoisi)* that have been together since July 20, 2012. To establish this bachelor group, two sets of two unrelated individuals were introduced to each other. The subsequently formed pairs were then introduced to each other. The initial pairings formed bonds that remain strong to this day. Once the troop was established, a clear dominance hierarchy was evident; however, over the last few years there has been an observable shift in the dominance order. A year's worth of behavioral data was collected to assess the troop's dynamics and quantify these observed changes. Following the assessment, a cooperative shifting plan was created and implemented. The goals of the training are to eliminate any displacement of subordinate individuals and allow zookeepers to easily shift all four individuals into indoor holding to facilitate servicing of the exhibit. Additionally, improvements were made to the crate training strategy used to move the langurs between buildings, which occurs twice each year.

## Background

The current troop is composed of "Chay", born September 3, 2008 at Toledo Zoological Gardens, "Fusui" (Fu), born September 5, 2007 at Lincoln Park Zoological Gardens, "Han" born December 4, 2007 at Oregon Zoo and "Sean" born August 31, 2006 at San Antonio Zoological Gardens & Aquarium. After clearing quarantine, Chay and Fu were introduced in an off exhibit building on December 7, 2011 and Han and Sean were introduced in a different off-exhibit building on February 21, 2012. Once the pairs were successfully introduced all four langurs were put together in their new building on June 20, 2012. As is common with Old World Monkey introductions, some aggression occurred during the introductions of the pairs, as well as with the full troop introduction, but nothing overly concerning or unexpected occurred. Periodic chasing and displacing is still observed by zoozookeepers. The pair bonds of Chay with Fu and Han with Sean have been strong from the beginning and remain well-established today. The initial dominance hierarchy within the pairs was Chay over Fu and Sean over Han, with Han and Sean ranking higher than Chay and Fu.

The troop is exhibited in an indoor, climate controlled, building in the winter and an outdoor exhibit in the summer, which requires moving them twice a year. The zoo's red panda pair occupy their exhibits in the opposite seasons. The buildings have different set-ups and sizes that require different management practices.

The indoor building is smaller but has an overhead chute connecting the two holding stalls (Figure 1), while the outdoor building has a larger area, dividable exhibit but no overhead chute between the stalls (Figure 2). When the troop is in the indoor exhibit, they are always given access to the exhibit and all of the holding are to provide them adequate space. The larger outside area allows them to be locked on exhibit during hours of operation without issue. Historically, the pairs have shifted into their respective holding stalls to be locked in together without issue to allow zookeepers to service the exhibit.

Following the troop's establishment, interactions between the langurs remained relatively calm through the end of 2013, at which point the instances of fights and subsequent wounds gradually increased, peaking in the first half of 2016 (Figures 3a and 3b). Beginning in 2015, zookeepers began noticing an increase in turmoil in the troop; frequently observing Chay going after Han and Sean with the occasional help of Fu. To better quantify and understand these changing dynamics a behavior study was embarked upon.

**Data Collection**

Beginning in December of 2015, behavioral observations were collected using an ethogram created specifically to monitor the changing troop dynamics and to document interactions between individuals (Figures 4 and 5). Specifically, the ethogram aimed to quantify positive and negative interactions, any displacement from food or enrichment, any patterns associated with aggression and overall time budget relative to conspecifics. A total of 120 ten-minute observations were collected between December 13, 2015 and the end of 2016. Fifty-five of the observations were conducted in the outdoor exhibit from April 17,2015 through October 30, 2015 and 64 observations took place in the indoor exhibit from December 13, 2015 through April 3,2015 and November 6, 2015 through December 21, 2015. All of these observations were conducted by the author to ensure data consistency and due to the langurs being difficult to quickly tell apart, except by their primary zookeepers.

**Results**

Analysis of the data showed several interesting patterns (see Figures 6 and 7 for complete data). Han and Sean spent more time in spacial proximity of each other (defined as close enough to touch) than Chay and Fu did. Additionally, Han and Sean engaged in more positive interactions with each other (defined as grooming each other and being in special proximity without any agnostic behavior) as compared to Chay and Fu (Figure 8). Negative interactions (defined as any form of displacing, chasing, fear grimacing or attacking) between the partners were, not surprisingly low, however the percentage of negative interactions between Chay and Fu, while still very small, were nearly eight times more common than those observed between Han and Sean. Positive interactions between any langur and one of their non-partners, were very low, as expected. One of the

surprising trends observed was that the dominant langur in each pair spent approximately twice as much time grooming their partner, compared to the time they were groomed by the partner.

Spacial usage of the exhibit was also analyzed (Figure 9), which showed all pairs being in the same section of the exhibit less than half the time, the pairs being together in opposite sections of the exhibit approximately one-third of the time, one individual in one section and the remaining three in the other less than one-fourth of the time and two non-paired individuals in each section two percent of the time. Of the observations of an individual being in a section alone and other three in the other section together it was Chay alone 37% of the time, Fu alone 27.3% of the time, Han alone 20.3% of the time and Sean alone 15.4% of the time. Both pairs spent the majority of the time in the same section with each other, but Han and Sean were in the same section more frequently than Chay and Fu.

When looking at the interactions of the langurs with individuals that were not their partner, the results show that the langurs spent a very small percentage of their time interacting in any manner with a langur that was not their partner (Figure 8). Of the documented interactions with non-partners, negative encounters were approximately five times more frequent than neutral or positive interactions. The negative interactions were comprised of Fu initiating the most aggression out of the four, and Sean being aggressed upon the most frequently. Full body checks are conducted by zookeepers during training sessions to look for wounds and assess overall health of each langur on a weekly basis, or as needed, following an observed fight or evidence of an altercation. All wounds are recorded in daily records and monitored closely by zookeepers. Langurs, like most Old World Monkeys, are resilient healers so often times injuries did not require veterinary intervention. For the cases where wounds were more severe they were treated with any combination of main medications, anti-inflammatorires, anti0biotics and topical flushes.

Additional notable observations were made during the study period related to diet, grooming and responses to aggression. In every instance when the troop was given access to food and/or browse, Chay and Fu would immediately go and start eating, while Han and Sean would wait before running to quickly grab items then carry them away. There were several observations of Fu stealing desirable food items from both Han and Sean, but never from Chay. Chay would also periodically displace Fu in order to take browse or desirable food items. Han and Sean were never observed taking or attempting to take food items. Han primarily groomed Sean, but there were a few instances where he was observed grooming Chay and Fu. No other langurs were observed grooming any individual that wasn't their partner. Han was never groomed by Chay or Fu. While Han never initiated any fights, there were occasional instances where he would attempt, unsuccessfully, to displace Chay; in response to these attempts Chay would hold his ground and Han would retreat.

**Analysis of Data**

The data supports the casual observations zookeepers had made prior to the study, that the langurs spend most of their time with their partner and little time with the other two langurs. Several data points shows an interesting result that wasn't necessarily obvious by casual observation; that Han and Sean's bond appears to be a stronger and less volatile bond, as compared to the bond between Chay and Fu. The fact that Sean received the highest amount of aggression directed toward him supports the conclusion that Chay and Fu were overtaking his previously held alpha status. The data shows a shift from Han and Sean, who previously were the pair to get desirable food items first, to Chay and Fu holding that position of dominance. Han's drop in social status, from second most dominant to most subordinate individual, is represented by him grooming Chay and Fu and not being groomed by them in return.

The breakdown of which individuals received wounds over the years reflects the shift in dominance hierarchy (Figure 3b). Aside from the wounds Sean incurred during the initial introductions to Han, he didn't receive any wounds while he was the alpha from 2012-2014. Once the dominance began to shift to Chay in 2015 and 2016, Sean received a total of 19 wounds. Once Chay was firmly established as the new alpha and the number of fights decreased, Sean has only received one wound since 2017. Similarly, Han didn't receive any wounds, aside from the one received during initial introductions to Sean in 2013 and only 3 in 2014, but in 2015 and 2016 when he lost his beta status and became the most subordinate individual, he sustained a total of 14 wounds. Han has only received two wounds since the 2017 after the troop dynamics stabilized. The number of wounds that Chay received annually was less after becoming alpha but is surprisingly low in 2015 and 2016, considering the number of altercations he was in while working to overthrow Sean. This can likely be explained by him being the one inflicting wounds and rarely being injured. Fu received the highest number of wounds in 2015 at the peak of he and Chay's overthrow of Han and Sean but continued to have a few each year and the most in 2018 so far, as a result of Chay's reduced tolerance of him.

**Challenges of Changing Troop Dynamic**

With Chay as the new alpha, Fu became increasingly reluctant to shift off of exhibit and be locked into a stall with him. Zookeepers would often observe Chay chasing and displacing Fu before the pair could be locked inside together, and aggressing upon him on the occasions where zookeepers were able to shift them in as a pair. The previous management practice of locking both pairs into their own stall to service the exhibit was no longer possible with this changing dynamic between Chay and Fu. In the indoor building, zookeepers were able to utilize the overhead chute to get Fu locked in the chute after Chay was secured in a stall; thus leaving an

empty stall to shift Han and Sean into. However, in the outdoor building, where there is no chute in holding, this was not an option and an alternative plan was needed.

The plan to address this new shifting issue was to train the troop for cooperative shifting and stationing. The ultimate goal of the training was to make shifting both pairs in together a much quicker and stress-free process, for both zookeepers and langurs, by having each langur go to their individual station to receive reinforcement without any individual being displaced.

*Training Plan*

Cue: Visual hanging shape that is different for each langur and a verbal "station"
Bridge: whistle
Criteria: Dominant individual shifts into stall and sits on his station, stays there calmly and allows subordinate animal to go to his station and be reinforced. Both stay on station and allow door to be closed behind them and until they are released from station.
Steps for Phase One:
1- Bridge and reinforce dominant animal every time he sits on his crate in front of his hanging station.
2- Add verbal "station" cue and point to station to draw his attention to the hanging station and reinforce for sitting calmly on crate.
3- Continue pairing station cue to the crate/hanging station until the cue is established. Can target him away from the station and give cue and bridge/reinforce when he goes to station.
4- Give dominant animal station cue, bridge and reward as soon as/every time he looks over at subordinate animal in doorway and/or if subordinate comes all the way into holding. Dominant animal must remain calmly on his statin without displacing subordinate animal.
5- Continue step 4 until he is consistently looking over at subordinate animal and the connection is established between reinforcement and the presence of the subordinate animal.
6- Give dominant animal station cue, bridge and reward for staying calmly on station and looking back at trainer once subordinate animal enters holding.
7-Repeat step 6 until the behavior is consistent.
8- Give station cue to dominant animal and bridge/reinforce (with high value peanuts) for staying calmly on station while a lower value reinforcement item (produce) is delivered to subordinate animal for coming into holding.
9: Continue step 8 as long as needed until criteria is consistently met.
10: Bridge/reinforce dominant animal staying calmly on station and focused on keeper while subordinate animal enters holding, receives produce and door is closed. At first will open door right away and build up to it being closed for longer periods of time.
11. Repeat step 10 until behavior is consistent and door is able to be closed for long enough to service exhibit.
Phase one is complete when the dominant animal will come to station when cued and remain there calmly, focused on the keeper while subordinate animal enters holding and received reinforcement; both allow door to be closed. Once door is closed and both monkeys have received their reinforcement they are both free to go/do whatever.
Steps for Phase Two:
1-Cue dominant animal to station and reinforce for allowing subordinate animal to receive reinforcement on platform near door. Door will not be closed at this step.
2- Once subordinate animal is consistently sitting on platform and dominant animal allows him to be reinforced without leaving station, begin closing door again.

3- Once both animals consistently stay on stations for door closing, move the subordinate animal's station to the crate on the mesh; subordinate animal's station is lower on mesh than dominant's to start with. Introduce subordinate animal's hanging station and introduce the verbal station cue. Dominant receives peanuts, subordinate produce.
4- Once both animals are consistently going to their respective stations on cue and dominant animal allows subordinate to be reinforced, move the dominant animal's crate lower and the subordinate's higher until they are level with each other. May need to do an intermediate step if this proves to be too big of a jump.
5- Once both are consistently stationing at level crates, move the subordinate animal's crate higher above the dominant's; may need to make gradual approximations to reach final locations based on their response.
6- Once both animals are consistently stationing at their final station heights begin using peanuts as reinforcement for both.
Behavior is complete when both animals go to their respective stations on cue, allow the door to be closed behind them and allow each other to be reinforced. Once door is closed, hanging stations are removed and monkeys are free to move about the stall.

Cooperative shifting and stationing were able to be trained for Han and Sean and are currently being used to shift them daily. Chay and Fu proved to be a much larger challenge with Chay frequently displacing Fu before much progress could be made on the behavior. The new area primary is currently working on training this behavior but in the meantime a modified shifting plan was created. Chay is the first to be called into an empty stall and then Fu is called into the other empty stall. Because of their lower rank, Han and Sean do not attempt to come inside where the opportunity for reinforcement exists while still with Chay and Fu, so locking the dominant two inside is not a problem. The next step is to utilize the dividable exhibit and get Han and Sean secured onto one half of the exhibit to clean and set up the empty half. Fu is then shifted out with Han and Sean. Because Fu is dominant over Han and Sean, when the door is opened to the set-up half of the exhibit, he shifts readily and the other two don't attempt to follow him. Chay can then be shifted out with Fu. Due to their dominance order, Fu is unlikely to shift over to food if Chay is already there. Lastly, Han and Sean can then be called into their stations to service the other half of the exhibit.

With the new dominance order established in the troop, modifications to the voluntary crate training plan were made that allowed all four to be voluntarily crated for the first time ever. In previous years only one or two langurs would voluntarily crate and the remaining individuals needed to be pushed into crates using aversive stimulus. With the modified plan, during training sessions, as well as for actual moving day, langurs were called into holding and crated in order of their dominance ranking. All training sessions, practice and actual crating, were conducted with windows blocked and no other langurs in holding, so they could not see troop mates being crated. Additionally, after a langur was crated, zookeepers carried them to the new building the longer way around so that the other langurs could not see that they had been crated and were being moved. In previous years the individuals seeing each other being locked in the crates and moved may have negatively affected the subsequent crate training sessions.

## Discussion

Bachelor troops are an important management tool for this endangered species to create placement for non-breeding males within the population. With a bachelor troop of unrelated Francois langurs being a relatively new management practice, there was not much previous history to go on so it was necessary to be vigilant to dominance order and any changing dynamics that occurred so that husbandry practices could be adjusted to best accommodate working with the troop. The decision to create bonded pairs before introducing the whole troop together proved to be an excellent management strategy as is has allowed for each langur to have a resource for confidence and normal social behaviors as well as aiding in shifting the troop. The Kansas City troop was intentionally formed of individuals close in age, but there is discussion amongst the SSP and TAG leadership about trying to form a troop with one older male and 2-3 younger males to create a father-like figure to possibly help manage aggression between male troop members. Regardless of the makeup of the troop, close observation of interactions between individuals, as well as a comprehensive training program are helpful tools for managing a bachelor group.

Since the conclusion of this study, zookeepers have begun noticing Chay and Sean spending increasing amounts time with each other and engaging in mutual grooming, beginning in January of 2018 and continuing through the present. To date, this new development has not resulted in any needed adjustments to husbandry or management practices but indicates another possible shift in the hierarchy in the future. Continued diligent observations of troop behavior will be necessary to maintain best management practice for this group.

## Acknowledgments

This behavioral study and the subsequent training of the troop would not have been possible without the support of my management staff and teammates on team Australasia. I would especially like to thank Stacia Peroni for her guidance in creating the cooperative shifting and station training plan and for her support of my study. Additional special thanks are due to Sara Markway for her dedication to taking over their training once becoming the area primary.

**Figure 1 - Indoor Climate-Controlled Building**
*Not to scale*

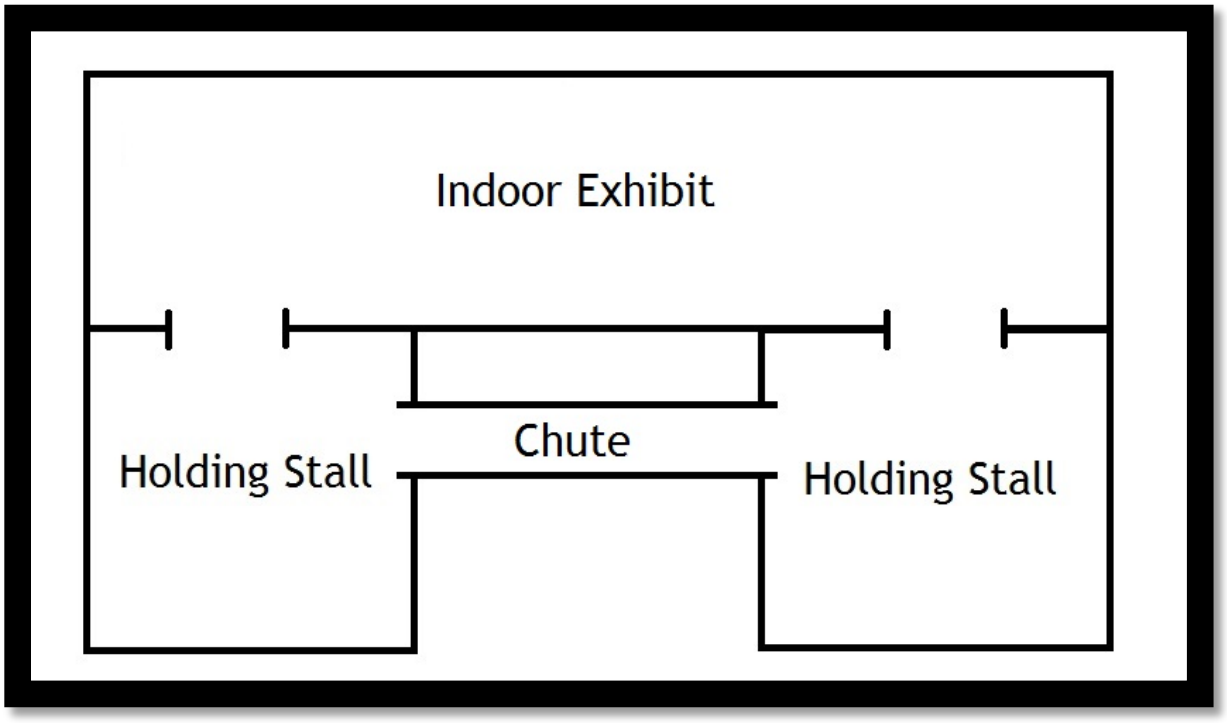


**Figure 2 – Outdoor Building**
*Not to scale*

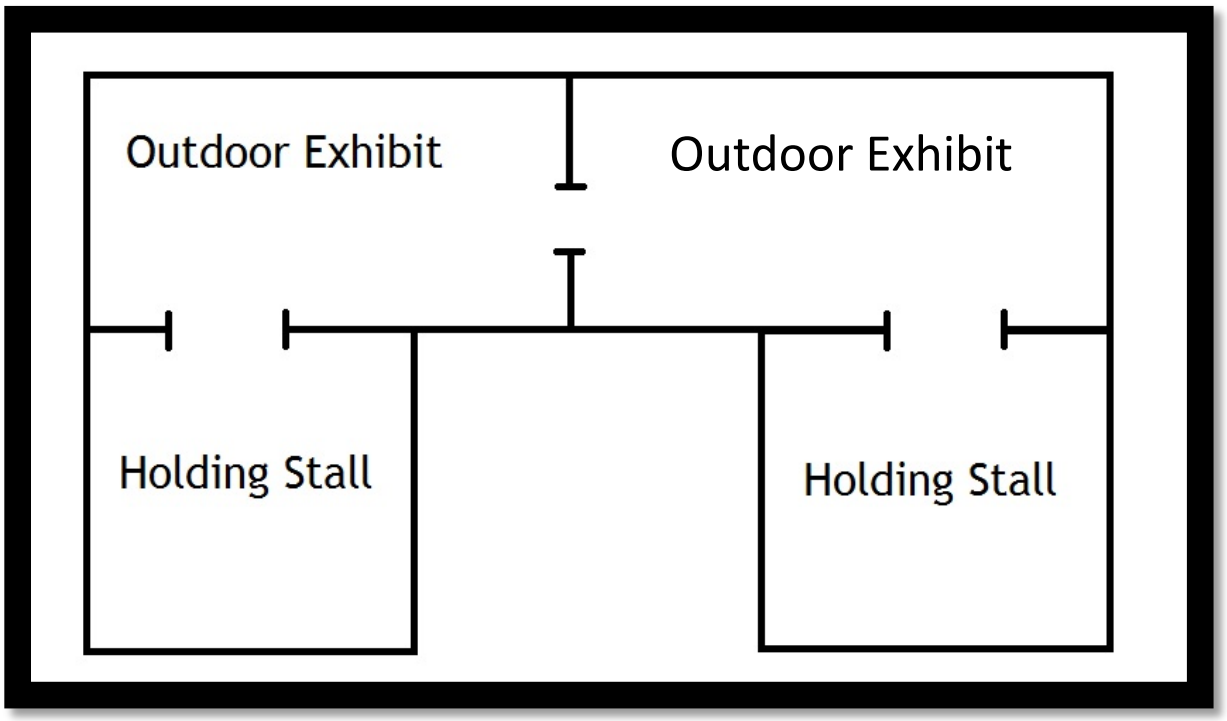

**Figure 3a – Wounds Sustained Since Formation of Troop**

| Dates | Number of Wounds Sustained | Number of Wounds Requiring Treatment* |
|---|---|---|
| 2012 | 3** | 2 |
| 2013 | 0 | 0 |
| 2014 | 10 | 1 |
| 2015 | 27 | 16 |
| Jan-Jun 2016 | 16 | 6 |
| July-Dec 2016 | 2 | 0 |
| 2017 | 3 | 0 |
| Jan -Sept 2018 | 6 | 2 |

*Treatment included oral pain medications, anti-inflammatories, antibiotics and/or a topical flush.

**All wounds in 2012 were from initial introductions

**Figure 3b – Number of Wounds Received Per Individual**

| Year | Chay Wounds | Fu Wounds | Sean Wounds | Han Wounds |
|---|---|---|---|---|
| 2012 | 0 | 0 | 2* | 1* |
| 2013 | 0 | 0 | 0 | 0 |
| 2014 | 4 | 3 | 0 | 3 |
| 2015 | 2 | 5 | 11 | 9 |
| 2016 | 2 | 3 | 8 | 5 |
| 2017 | 0 | 3 | 0 | 0 |
| 2018 | 1 | 4 | 1 | 0 |

*All wounds in 2012 were from initial introductions

**Figure 4 – Ethogram**

| Category | Behavior | Code | Description of Behavior |
|---|---|---|---|
| **Social** | Grooming a conspecific | GC | Uses hands and/or mouth to pick through fur and/or mouth of conspecific, excluding anogenital region |
| | Being groomed by a conspecific | BG | A conspecific is picking through their hair with hands and/or mouth |
| | Chasing a conspecific | C | Actively pursuing conspecific |
| | Being chased by a conspecific | BC | Moving away from conspecific who is actively pursuing them |
| | Displacing a conspecific | DC | Moving toward a conspecific who then moves away as a result |
| | Being displaced by a conspecific | BD | Moving away from a space when a conspecific approaches |
| | Attacking a conspecific | A | Aggresing on a conspecific; involving physical contact |
| | Being attacked by a conspecific | BA | Being aggressed on by a conspecific; involving physical contact |
| | Inspect anogenital region of conspecific | I | Uses hands or mouth to investigate and/or groom anogenital region of conspecific |
| | Having anogentital region inspected by conspecific | IC | A conspecific uses hands or mouth to investigate or groom anogenital region |
| | Sitting next to conspecific | SC | Resting in spacial proximity to conspecific |
| | Baring teeth to conspecific | BT | making any threatening facial gestures to conspecific |
| | Vocalizing | V | grunting, barking, screaming, etc. |
| **Enrichment** | Interact with enrichment | IE | Smells, touches or manipulates an enrichment item |
| | Displace conspecific from enrichment | DE | Chases conspecific away from a desired enrichment item |
| | Displaced from enrichment by conspecific | ED | Drops/leaves an enrichment item currently using when approached my conspecific |
| **Solitary** | Grooming self | GS | Uses hands and/or mouth to pick through own fur |
| | Resting | R | Staying stationary but is awake and alert to environmental changes |
| | Sleeping | S | Staying stationary but eyes are closed and is not alert to environmental changes |
| | Locomoting | L | Walking, climbing, swinging or running from one place to another |
| | Interact with environment | IV | Peeling bark of perching, picking up mulch, etc. |
| **Food** | Eating diet | E | Eating a piece of food from diet |
| | Eating enrichment item | EE | Eating an enrichment item |
| | Drinking | D | Drinking water |

**Figure 5 – Example Data Collection Sheet**

**Langur Ethogram** Date: _____ Time:_____ Exhibit:_____

**BEHAVIORS**

| | *Social* | | | | | | | | | | | | | *Enrichment* | | | *Solitary* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **TIME** | GC | BG | C | BC | DC | BD | A | BA | I | IC | SC | BT | V | IE | DE | ED | GS | R | S | L | IV | E | EE | D |
| 0:00 | | | | | | | | | | | SH | | | | | | F | CS | H | | | | | |
| 0:30 | | | | | | | | | | | SH | | | | | | F | CS | H | | | | | |
| 1:00 | | | | | | | | | | | SH | | | | | | F | CS | H | | | | | |
| 1:30 | | | | | | | | | | | SH | | | | | | | CS | H | F | | | | |
| 2:00 | | | | | | | | | | | SH | | | | | | | | H | F | | S | | C |
| 2:30 | | | | | | | | | | | SH | | | | | | | | H | F | | SC | | |
| 3:00 | | | | | | | | | | | SH | | | | | | | SC | H | F | | | | |
| 3:30 | | | | | | | | | | | | | | | | | | all | | | | | | |
| 4:00 | | | | | | | | | | | | | | | | | | all | | | | | | |
| 4:30 | | | | | | | | | | | | | | | | | | all | | | | | | |
| 5:00 | | | | | | | | | | | | | | | | | C | SH | | F | | | | |
| 5:30 | | | | | | | | | | | | | | | | | | all | | | | | | |
| 6:00 | | | | | | | | | | | FC | | | | | | | all | | | | | | |
| 6:30 | | | | | | | | | | | FC | | | | | | | all | | | | | | |
| 7:00 | | | | | | | | | | | | | | | | | | all | | | | | | |
| 7:30 | | | | | | | | | | | | | | | | | | all | | | | | | |
| 8:00 | | | | | | | | | | | | | | | | | | all | | | | | | |
| 8:30 | | | | | | | | | | | | | | | | | | all | | | | | | |
| 9:00 | | | | | | | | | | | | | | | | | | all | | | | | | |
| 9:30 | | | | | | | | | | | | | | | | | | all | | | | | | |
| 10:00 | | | | | | | | | | | | | | | | | all | | | | | | | |

*Mark an S for Sean, H for Han, a C for Chay and an F for Fu in which ever box corresponds with the behavior at that time

**Figure 6 -Time Budget of Langurs During Observations**

| BEHAVIOR CATEGORY | BEHAVIOR | CHAY | FU | HAN | SEAN |
|---|---|---|---|---|---|
| Positive Interaction With Partner | Grooming Partner | 4.2% | 2.0% | 1.6% | 4.0% |
| | Being Groomed By Partner | 2.1% | 4.1% | 3.9% | 1.6% |
| | Spacial Proximity of Partner | 26.1% | 25.2% | 34.3% | 35.2% |
| Negative Interaction with Non-Partner(s) | Negative Interaction Toward Non-partner(s) | 2.1% | 3.3% | 0.1% | 1.4% |
| | Aggressed on by Non-partner(s) | 1.4% | 1.2% | 2.6% | 3.2% |
| | In Spacial Proximity with Non-Partner(s) with Agnostic Behavior | 0.2% | 0.0% | 0.3% | 0.2% |
| Positive Interaction With Non-Partner(s) | Grooming Non-Partner(s) | 0.0% | 0.0% | 0.1% | 0.0% |
| | Being Groomed by Non-Partner(s) | 0.0% | 0.1% | 0.0% | 0.0% |
| | In Spacial Proximity with Non-Partner(s) no Agnostic Behaviors | 0.7% | 0.3% | 0.4% | 3.7% |
| Negative Interaction with Partner | Negative Interaction from Partner | 0.1% | 0.5% | 0.1% | 0.0% |
| | Negative Interaction Toward Partner | 0.3% | 0.1% | 0.0% | 0.1% |
| All Other Non-Interactive Behaviors | Other | 62.8% | 63.2% | 56.6% | 50.6% |

*Author's Note: Each langur has a different number of total observed behaviors due to them being non-visible at various observation points*

**Figure 7- Breakdown of All Interactive Behaviors**

| BEHAVIOR CATEGORY | BEHAVIOR | CHAY | FU | HAN | SEAN |
|---|---|---|---|---|---|
| Positive Interaction With Partner | Grooming Partner | 11.2% | 5.5% | 3.6% | 8.6% |
| | Being Groomed By Partner | 5.5% | 11.2% | 8.7% | 3.5% |
| | Spacial Proximity of Partner | 69.1% | 68.2% | 76.9% | 75.9% |
| Negative Interaction with Non-Partner(s) | Negative Interaction Toward Non-partner(s) | 5.6% | 8.9% | 2.1% | 3.0% |
| | Aggressed on by Non-partner(s) | 3.7% | 3.1% | 5.9% | 6.9% |
| | In Spacial Proximity with Non-Partner(s) with Agnostic Behavior | 0.5% | 0.0% | 0.6% | 0.4% |
| Positive Interaction With Non-Partner(s) | Grooming Non-Partner(s) | 0.0% | 0.0% | 0.3% | 0.0% |
| | Being Groomed by Non-Partner(s) | 0.0% | 0.1% | 0.0% | 0.0% |
| | In Spacial Proximity with Non-Partner(s) no Agnostic Behaviors | 1.8% | 0.8% | 0.9% | 0.8% |
| Negative Interaction with Partner | Negative Interaction from Partner | 0.4% | 1.3% | 0.2% | 0.0% |
| | Negative Interaction Toward Partner | 0.9% | 0.4% | 0.0% | 0.2% |

*Author's Note: Each langur has a different number of total observed behaviors due to them being non-visible at various observation points*

**Figure 8 –Social Interactions as a Percentage of Total Observations**

| Langur | Positives with Partner | Negative with non-partner(s) | Positive with non-partner | Negative with Partner | No Interaction |
|---|---|---|---|---|---|
| **Chay** | 32.4% | 3.7% | 0.7% | 0.5% | 62.7% |
| **Fu** | 31.4% | 4.4% | 0.4% | 0.5% | 63.3% |
| **Han** | 39.8% | 3.9% | 0.5% | 0.1% | 55.7% |
| **Sean** | 40.7% | 4.8% | 0.4% | 0.1% | 54.0% |

**Figure 9 – Spacial Usage of Exhibits**

| Location | Percentage |
|---|---|
| All Four in Same Section | 42.7% |
| One Pair in Each Section | 33.2% |
| Three in One Section, Single in Other | 22.1% |
| In section alone with Non-Partner | 2.0% |